NOVEMBER 1951

PRECISION METAL MOLDING

INCLUDING DIE CASTINGS MAGAZINE

DIE CASTINGS
INVESTMENT CASTINGS
POWDER METALLURGY
PERMANENT MOLD CASTINGS
PLASTER MOLD CASTINGS

PMM

DESIGN • MANUFACTURE • FINISHING • USE

ALUMINUM PERMANENT MOLD CASTINGS

also sand-cored and heat-treated

HIGH PRESSURE ALUMINUM DIE CASTINGS

machined, finished, assembled

CERTIFIED ZINC DIE CASTINGS

polished, buffed, plated, painted

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4 STAR SERVICES... MONARCH'S completely integrated manufacturing and mass-production facilities meet industry's most exacting requirements...offer plus values of product finishing and complete assembly work, all in one plant. We invite you to investigate our unique facilities... engineering, technical and production... coordinated to solve your casting problems practically and economically.

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WRITE TODAY for your copy of our new "FACTFILE" folder which illustrates and describes Monarch's outstanding facilities. You'll want it for your castings source file.

MONARCH ALUMINUM MFG. COMPANY • Bedford Ave. at W. 93 St., Cleveland 2, Ohio

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KUX

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USED BY

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FIRST NAME IN COIN CONTROL DEVICES

The desire for a soft drink or a candy bar, . . . a vending machine and a coin. They're the ingredients it takes to make "magic with a nickel!" Right before your eyes, a miracle of miracles takes place. The proper change is returned plus the refreshment . . . all due to a remarkable behind-the-scenes mechanism made by NATIONAL REJECTORS, INC.

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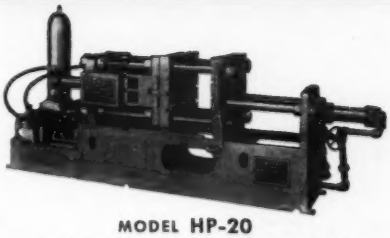

MODEL HP-20
Hydraulically operated die casting machine for production of aluminum castings.

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KUX MACHINE COMPANY
6725 N. RIDGE • CHICAGO 26, ILLINOIS

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SELECTED BY FIRST NAMES IN INDUSTRY

NOVEMBER 1951
Vol. 9 No. 11

PRECISION METAL MOLDING

DIE CASTINGS • INVESTMENT CASTINGS • POWDER METALLURGY
PERMANENT MOLD CASTINGS • PLASTER MOLD CASTINGS

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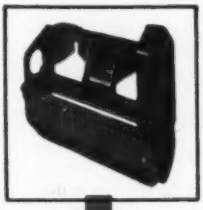

Mere size has never been the determining factor in these services. Far more important is the ADVANCE tradition of extra care and attention for every die-casting problem.

This tradition has meant the organization of a staff of expert engineers, skilled metallurgists and careful craftsmen; the establishment of complete facilities, including custom tooling, in one plant, and a policy of always turning out a better product at the right cost.

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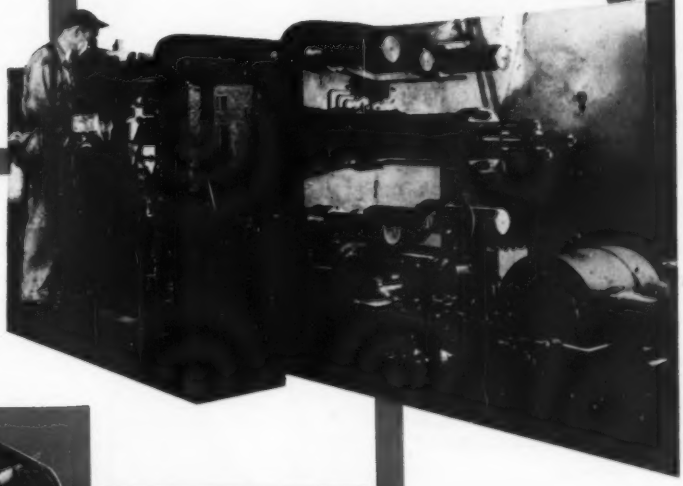
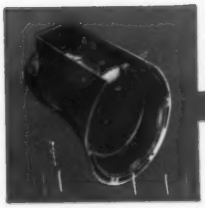
Consult with us without obligation on how we may contribute to the solution of any die-casting problem you may have.





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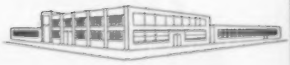

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Place your die casting responsibilities with Newton-New Haven. Here is an organization that has the equipment, the personnel, the experience and the whole-hearted desire to help.
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LETTERS TO THE EDITOR

M.E.'s INTERESTED

Our mechanical engineering section is interested in the article *Close Weight Tolerances on Truck Governor Weights Made by Powder Metallurgy*, by R. R. Abbott, which appeared in the September 1951 issue of your magazine, pages 38-9 and 93-4. If reprints or tear sheets of this are available, we would appreciate it very much if we could have a copy.—E. M.

Tear sheets sent.—Ed.

AIRCRAFT ENGINE CASTINGS

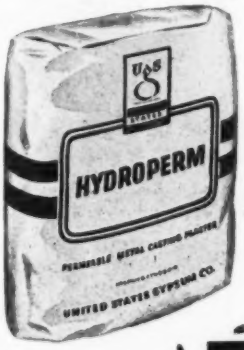
We are at present getting underway on an aircraft engine program involving some die castings and permanent mold casting work. Since this is rather new to us we would like to gather all the information available on these subjects, and would appreciate your sending the entire set of literature indicated on the enclosed card. In the event that this request for the entire mailing list imposes an excessive burden on your staff we would appreciate any and all of the articles you can forward us. — K.S.T.

Items referring specifically to die casting and permanent mold casting are being requested from the various sources and should be received by you in the near future. We have also sent a list of a few books and other sources of dependable information on these subjects for your reference.—Ed.

INCREASED SCOPE

We have received several copies of your re-named publication, Precision Metal Molding, formerly Die Casting Magazine. We believe that by including powdered metals and other metal moldings, you are greatly increasing the scope and value of your publication. We are giving copies of the publication to our engineering and manufacturing departments and believe that they will profit from it.—K.B.N.

It's here!



New Permeable Metal Casting Plaster for Non-Ferrous Casting

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Smoother Molds...Better Castings

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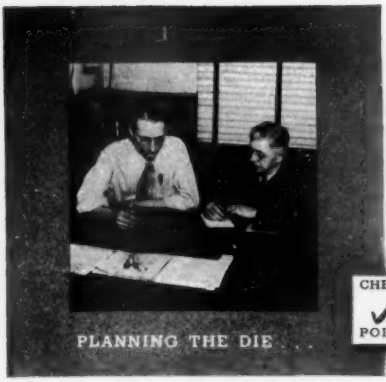

PLANNING THE DIE . . .

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CHECK ✓ POINT

16-POINT
PRODUCTION CONTROL SYSTEM WORKS FOR YOU!

The Finished Casting

WHEN you place your Die Casting order with Parker, a unique control system goes to work for YOU. From the original planning stage through the finished casting, 16 important check points assure perfect castings. Every phase of production is carefully checked so that alloys, tolerances and designs meet the most exacting requirements. This 16-Point Production Control System is a result of Parker's half-century of experience—another example of how that experience pays off for YOU.

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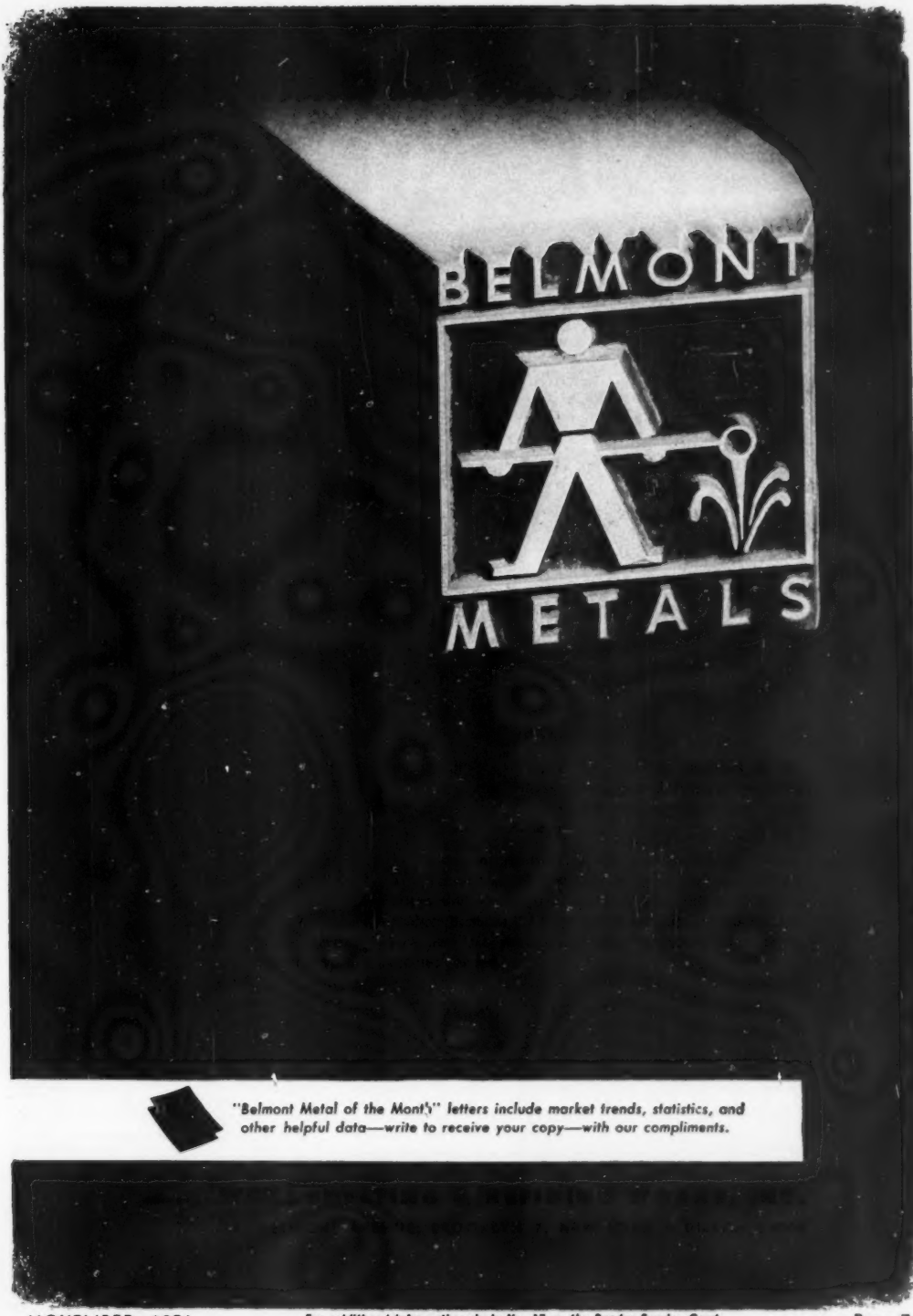
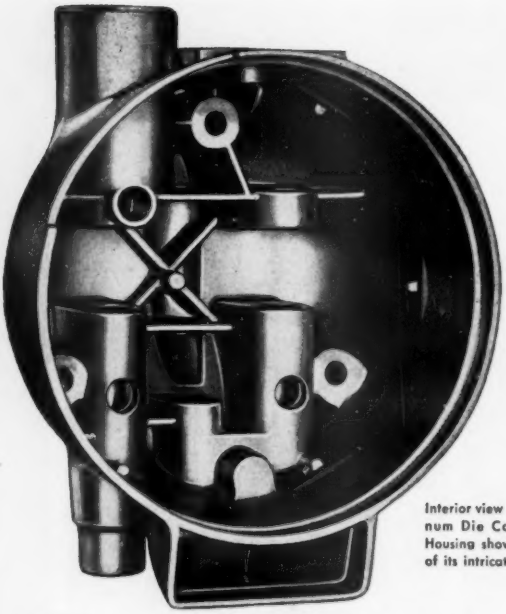


"Belmont Metal of the Mont'h" letters include market trends, statistics, and other helpful data—write to receive your copy—with our compliments.



Interior view of aluminum Die Cast Gear Housing shows details of its intricate design.

Intricate Design is No Bar to Mass Duplication

Design engineers have learned over the years that component parts, extremely intricate in design, can be mass produced within close tolerances by the die casting process. They have found that MILWAUKEE has the knowledge, the experience, the technical skill, and the facilities to execute complex design to exact specifications.

The die-cast gear housing pictured above is but one in thousands of such intricate designs which are faithfully mass produced here at Milwaukee. Its smooth, streamlined exterior "covers" a multitude of "interior problems" involving die design, die construction and machine operation. Then consider the fact that die cast parts like this are delivered to the customer, in most cases, practically "ready for assembly."

Consider, also, the savings which accrue to the user of such parts... in machining operations... in assembly time... in buffing, polishing and finishing. Whether you're designing for military or civilian needs, remember that die castings by *MILWAUKEE* may be the low-cost way to mass-produce your most complex components.

MILWAUKEE DIE CASTING COMPANY
1019 N. FOURTH STREET • MILWAUKEE 3, WISCONSIN

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OFFERED IN THIS MONTH'S ADS

NOTE: Circle numbers on the enclosed post-card to indicate literature, samples or trial services you wish to receive.

No. 1. A SMALL DIE CASTING MACHINE that will cycle over 1000 times per hour is illustrated and described in literature offered by the A. B. C. Die Casting Machine Co.

No. 2. DETAILS ON BURNISHING MATERIAL for barrel finishing of military and civilian parts offered by The Abbott Ball Company.

No. 4. ENAMEL FILLING OF RECESSES in die cast parts is illustrated and described in literature available from the Acromark Co.

No. 7. "WE'RE GEARED FOR YOUR DEFENSE NEEDS" is a booklet explaining the Advance Tool & Die Casting Co.'s facilities for producing die castings.

No. 8. FULL INFORMATION on the Ajax Induction Melting Furnaces as to applications, features and specifications is offered by Ajax Engineering Corp.

No. 9. "ADVANCED BARREL FINISHING" is the title of a booklet offered by Almco Division, Queen Stove Works, Inc. The booklet gives details of the Supersheen method of controlled barrel finishing.

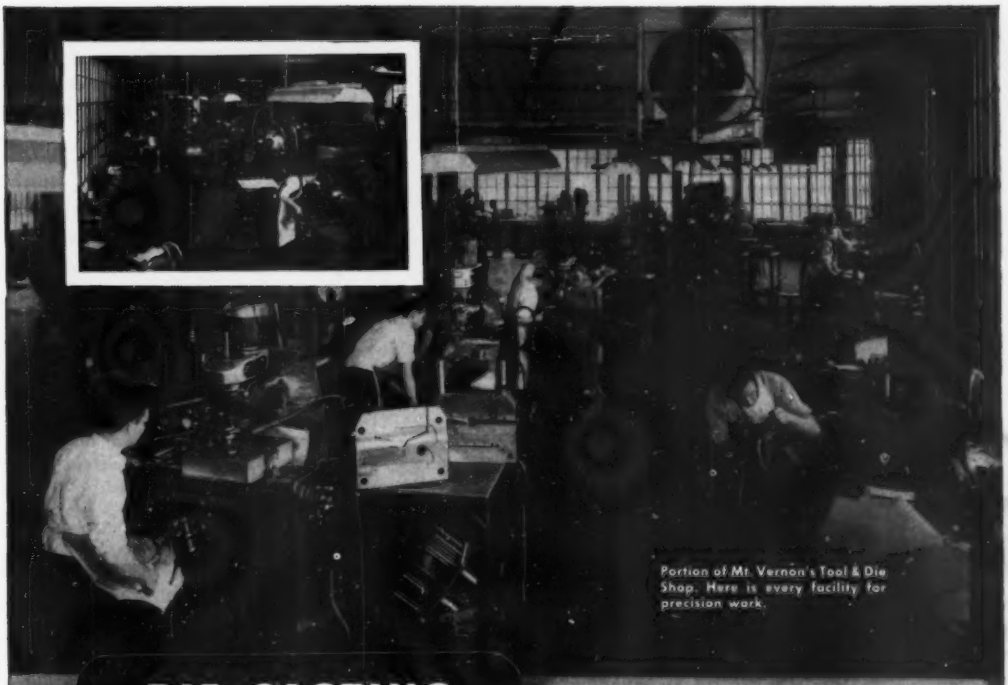
No. 13. "A CRITICAL SURVEY OF INVESTMENT CASTINGS" is a booklet being offered by the Arwood Precision Casting Corp.

No. 16. USE OF ROTARY FEED TABLES to save time and money on the production line is the subject of bulletin T-80 from the Bellows Co.

No. 17. MARKET TRENDS, STATISTICS and other helpful data are included in the "Belmont Metal of the Month", news letters available from Belmont Smelting & Refining Works, Inc.

No. 20. LAPPING MACHINES which eliminate the need for gasketing complex die cast shapes are described in a booklet from Crane Packing Co.

No. 22. REPORTS OF "ON THE JOB SUCCESS" and economy of operation of the Dumore Automatic Drill Head are available from The Dumore Company.



Portion of Mt. Vernon's Tool & Die Shop. Here is every facility for precision work.

DIE CASTING

Dependability is Assured here!

At Mount Vernon, we have completely coordinated designing, engineering and die building facilities *under one roof.* The activities of our modern and extensive die shop are closely integrated with those of other departments, with the result that long-life, accurate dies—yielding clean, flawless castings—are assured.

When considering a manufacturing procedure, therefore, remember not only the outstanding economies inherent in die casting, but also

Mount Vernon's Complete Four-Fold Service

(1) Consultation — M. V. can help you with design and production problems by making recommendations based upon your specific requirements.

(2) Die Making — M. V's up-to-the-minute tool and die shop equipment, plus long experience and highly skilled personnel, assure a dependable source for quality dies.

(3) Castings — M. V. castings, meeting ADCI standards, are guaranteed "on grade" at all times.

(4) Machining — M.V. machining facilities can handle every machining operation that castings may require.

We shall welcome the opportunity to serve, and assist you—as we have assisted many others—to increase your output, improve your products, and *hold down your production costs.*

MT. VERNON
DIE CASTING CORP.
MT VERNON NEW YORK

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The meaning of a signature!

Through a quarter of a century of knowing how, the SUPER CAST reputation for Better Methods—Better Die Castings, has been recognized.

Sound engineering, metallurgical knowledge and skilled techniques have achieved and maintained a standard of superior quality.

SUPER CAST has kept faith, always deserving the mark it bears. SUPER CAST means die castings for those who want the best.

A sound, time-tested institution and a sound time-tested product have won confidence and widespread endorsement.

THE SUPERIOR DIE CASTING COMPANY

1001 London Road CLEVELAND 10, OHIO

Detroit Chicago Pittsburgh
Philadelphia New York

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No. 23. STEP-BY-STEP INSTRUCTIONS for the use of Enthone metal and enamel strippers, blackening processes and emulsion cleaner are offered by Enthone, Inc.

No. 25. BUFFING WHEELS and compounds and other finishing supplies are illustrated and described in literature from the Formax Mfg. Corp.

No. 27. SAMPLE PARTS will be processed free of charge in Globe tilting tumbling barrels. Information on this service is available from the Globe Stamping Div., Hupp Corp.

No. 33. HYDRAULIC PRESS MFG. CO.'s new aluminum die casting machine which can make aluminum castings up to 12 lbs. in weight is described in a catalog offered by HPM.

No. 36. THE COMPLETE LINE of die casting machines manufactured by the Kux Machine Company is presented in an illustrated catalog.

No. 37. LITERATURE AND DESIGN INFORMATION on aluminum and magnesium die castings are available from Litemetal Dicast, Inc.

No. 39. FILTERS FOR HYDRAULIC and circulating systems are the subject of a detailed study issued by Marvel Engineering Company.

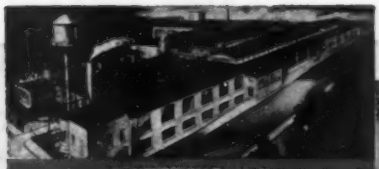
No. 41. IMPREGNATION OF POROUS CASTINGS by the Mogullizing system is explained in literature offered by the Metallizing Company of America.

No. 45. BARREL FINISHING with compounds manufactured by the Minnesota Mining & Mfg. Co. is covered in a booklet published by the company. The booklet shows typical metal parts before and after barrel finishing, and makes recommendations for the proper compound.

No. 46. "STEP UP PRODUCTION" is a booklet containing actual case histories of how plants have cut costs and increased production by using Minnesota Mining & Mfg. Co.'s 3M Abrasive Belts.

No. 47. "BLACK MAGIC," a black oxide finish which can be hand applied or used with fully automatic equipment, is described in a catalog offered by the Mitchell-Bradford Chemical Co.

continued on page 47



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In War or Peace *depend on* DIE CASTINGS from PRECISION'S *7 Completely Equipped* PLANTS

In defense and civil production, there is increasing need for lighter, stronger, exactly accurate products and components at lower cost. The answer is *Precision Die Castings*—durable, dependable, designed to solve your production problems by the foremost engineering skill in the die casting industry.

Call a PRECISION Engineer *today!*

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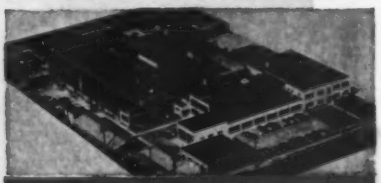

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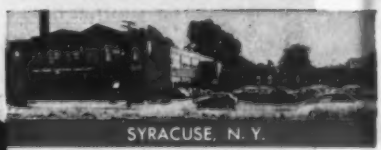

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SYRACUSE, N. Y.

**Since 1909 the name "Precision" has been the symbol of highest quality in the die casting industry.*

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Syracuse, N. Y. · Cleveland, O. · Kalamazoo, Mich. · Chicago, Ill.
British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

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"balance, 99.99+% zinc"*

DESIGNATION & COMPOSITION OF ZINC DIE CASTING ALLOYS:

	REFERENCE DESIGNATION	ALLOY 2	ALLOY 3	ALLOY 5
	NOMINAL COMPOSITION	Copper 2.5-3.5% Alum. 3.5-4.5% Mag. .02-.10%	Alum. 3.5-4.3% Mag. .03-.08%	Copper .75-1.25% Alum. 3.5-4.3% Mag. .03-.08%
ASTM	*American Soc. for Testing Materials*	*B86—XXI*	*B86—XXIII*	*B86—XXV*
SAE	*Society of Automotive Engineers*	*921*	*903*	*925*
NAVY	*U.S. Navy*		*46Z2b—Class A*	*46Z2b&c—Class B*
ARMY	*U.S. Army*		*57-93-2A Alloy A*	*57-93-2A Alloy B*
FED	*Federal Specifications*		*QQZ—363A*	*QQZ—363B*

The phenomenal growth of the die casting industry—the second largest consumer of zinc today—was chiefly provided by the development of "four-nines" metal—which is standard for all zinc alloy die castings.

Prior to 1928, the year Bunker Hill pioneered the production of "four-nines" metal, zinc die castings based on lower grade metal were restricted in their applications due to limitations in physical properties. But as soon as industry was enabled to write "balance 99.99+% zinc" into their specifications, the quality and stability required in die castings were available and the use of zinc alloy castings increased enormously. Die Casting—the shortest distance between raw material and finished product—proved the answer to industry's need for accurate, high-speed and low-cost production of the most complex parts, in a single operation, just as zinc has proved itself as the ideal base metal for die castings. Currently over 70% of all die castings by weight are made of zinc.

DIE CASTING is the Process · ZINC, the Metal · BUNKER HILL, THE PREFERRED ZINC

BUNKER HILL 99.99+% ZINC

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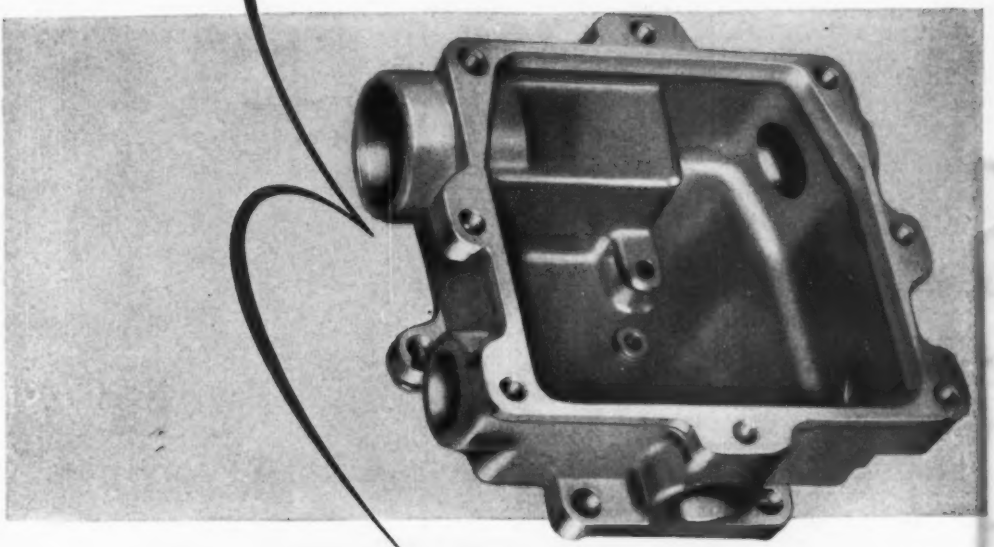
Flexible DESIGN POTENTIALS



with **MADISON-KIPP** *Zinc and Aluminum* **DIE CASTINGS**

Space limitations, usage and other reasons may dictate a complicated part like the precision airplane switch housing illustrated. There are cored holes and bosses on six sides plus an interlocking core. The Madison-Kipp die casting process is ideal for producing these "special" shapes and offers the designer great flexibility within a reasonable cost budget. Please send all inquiries to our home office in Madison, Wisconsin.

MADISON-KIPP CORPORATION

213 WAUBESA STREET, MADISON 10, WIS., U.S.A.

ANCIENS ATELIERS GASQUY, 31 Rue du Marais, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

For additional information circle No. 38 on the Reader Service Card

2 first quality die steels

for every die casting need!

hotform

The famous original 5.00% chromium steel, known and used by die casters everywhere for aluminum and white-metals casting. No movement in hardening — no surface pitting — good machining qualities . . . matchless advantages for your jobs!

Speed-Cut

...ishing in heat-treated con... ...ar-tempersible to 325 Bri... ...ch higher when oil quenched. ... CUTS remarkable prepar... ...e is your profitable choice ...rt-run dies, holder blocks, ... molds and mold plates!

Upon request to our Sales Department, complete information on the composition, heat treatment and use of HOTFORM and SPEED-CUT will be furnished gladly, without obligation.

Vanadium-Alloys

STEEL COMPANY

LATROBE, PA.

COLONIAL STEEL DIVISION OF ANCHOR DRAWN STEEL CO.

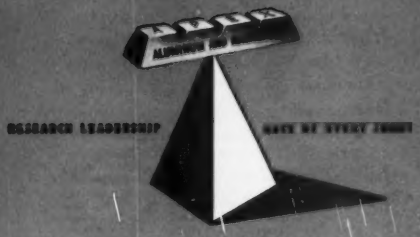
APEX

ALUMINUM • MAGNESIUM • ZINC BASE

DIE CASTING ALLOYS

Dependable high quality die cast alloy ingot—an important factor in production for dependable die castings—made to exacting specifications—complete Spectrograph and Quantometer control from raw material to the finished alloy—assuring uniform composition—less production problems—more customer satisfaction

Buy the Best—Buy APEX.



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More power with Kaiser Aluminum

TODAY there is an immense demand for automotive-type cast aluminum pistons for tanks and trucks vitally needed in our preparedness program.

To help meet this demand, Kaiser Aluminum is supplying increasing quantities of aluminum pig and specification ingot to major producers of pistons . . . providing a variety of alloys to meet exacting government specifications.

At the same time, of course, our Newark, Ohio, plant is supplying specification ingot and extrusion billets—and our Spokane, Washington, plant supplies pure and standard alloy pig—for scores of other essential products: From cylinder heads to structural aircraft parts, from hydraulic transmissions to cast truck and trailer wheels.

Our engineering and technical knowledge acquired in these varied fields may help you. Call today! Sales offices in principal cities. Kaiser Aluminum & Chemical Sales, Inc., Oakland, Calif.

Kaiser Aluminum

Setting the pace—through quality and service

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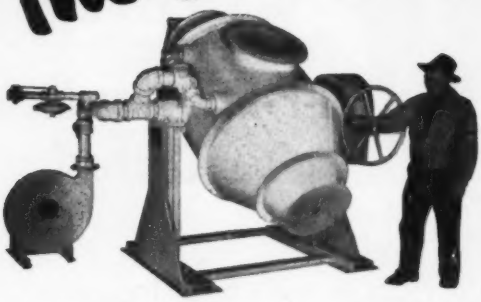
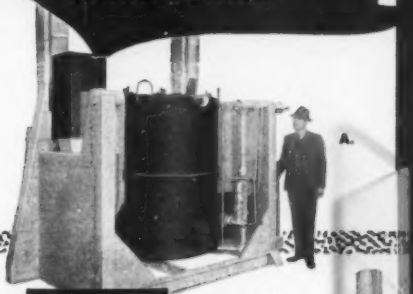
The Foremost Furnaces

for Melting any type of Non-Ferrous Metals in Foundries, Die Casting and Permanent Mold Plants



STROMAN MODEL "BFC" HAND TILT BARREL TYPE MELTING FURNACE FOR ALUMINUM

Featuring "Tangential Firing" which produces a most efficient combustion condition, creating a melting atmosphere that keeps metal loss and dross accumulation at a minimum. Charges through the top or rear door which is also used for drossing metal and cleaning the furnace. Built in 500 lb. capacity and larger. Oil or gas fire.

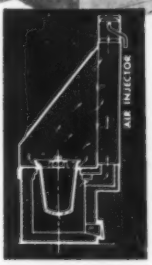


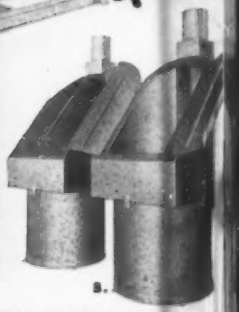
A.

STROMAN MAGNESIUM AND ALUMINUM MELTING AND HOLDING FURNACES

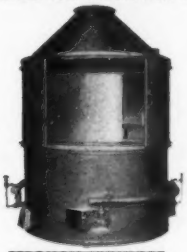
A. Hydraulic Tilt Magnesium and Aluminum melting furnace handling from 500 to 3000 lbs. of aluminum. Incorporates the famous Stroman Stationary Lip Pour, which creates a constant pouring arc at any desired pouring speed. Saves time and metal.

B. Stationary Super-Heating or Melting Furnaces, Type S. F. Designed to deliver the correct super-heat to magnesium after it has been melted in larger furnaces, and before it is poured into the molds. Can also be used for breakdown or holding. They have all safety features. Are available for cast steel pots or fabricated steel pots. Furnaces may be equipped with hoods if so desired, for the venting of combustion and other gasses. Write for bulletin No. 100.





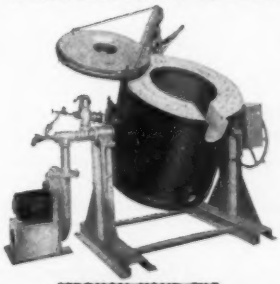
B.



STROMAN IRON POT MELTING FURNACES FOR ZINC OR ALUMINUM

These furnaces are highly recommended as breakdown furnaces for zinc and aluminum die casting and permanent mold plants. They also excel as holding furnaces. They can be supplied either with or without hoods to exhaust fumes and heat. Their construction causes longest pot life and lowest fuel costs. Choice of automatic or manual controls and oil or gas fire. Capacities from 212 to 14,000 lbs. zinc.

Write for Bulletin No. 115



STROMAN HAND TILT CRUCIBLE MELTING FURNACE FOR BRASS, BRONZE, ALUMINUM AND OTHER ALLOYS

Capacities from No. 40 to No. 300 Crucible. Most efficient in operation. Rugged construction assures longest life and trouble-free operation. Oil, Gas or Combination Fire.

Write for Bulletin No. 105

STROMAN TYPE "MC" ALUMINUM DIP-OUT REVERBERATORY FURNACE

Bath capacity from 500 to 10,000 lbs. Aluminum

A combination of breakdown and holding furnaces makes this the most economical furnace ever designed for aluminum melting. It can be used for melting, holding, alloying, fluxing, for either casting or producing ingots. Cold metal does not reach the molten bath. Hot metal is always available for dipping. No iron pots or crucibles to buy. Oil, gas or combination oil-gas fire. Complete automatic controls are available if desired.

WRITE FOR COMPLETE CATALOGUE ON ALL TYPES OF FOUNDRY EQUIPMENT

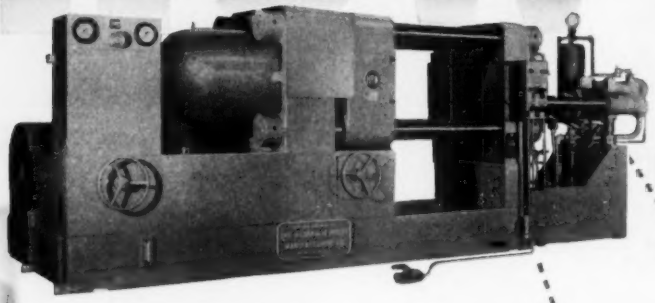
STROMAN FURNACE & ENGINEERING CO.

DIVISION OF

THE PETERSEN OVEN CO. • 9900 FRANKLIN AVE. • FRANKLIN PARK, ILL.

new

H-P-M's Aluminum *Die Caster!*

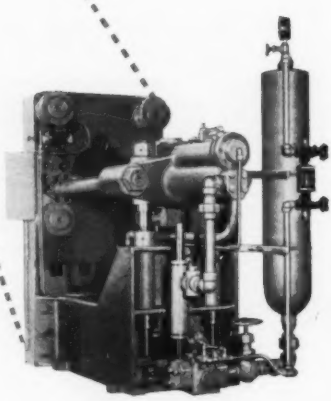


with Built-In Nitrogen Accumulator for INCREASED INJECTION SPEED!

for ALL-HYDRAULIC HIGH PRODUCTION of PRECISION PARTS . . .

● Here's a brand new, high-speed die casting machine for making large aluminum castings up to 12 lbs. in weight. Listed below are just a few of the H-P-M design features which make this new die caster second to none:

- High-speed plunger advance . . . up to 400 ft. per minute.
- Positive, instantaneous injection pressure build-up . . . no pre-fill valve to close.
- Maximum injection pressure when die is filled . . . no drop off of pressure.
- Built-in hydraulic ejectors save time, greatly reduce die costs and minimize operator fatigue.
- Rugged straight-line "All-Hydraulic" die clamp with few moving parts, assure positive die alignment . . . die change-over is simple and fast.
- Dual hydro-electric safety devices guard against premature injection.
- Plenty of space around die mounting surfaces for installation of core pull cylinders.
- Independent handwheel adjustments for both die clamp and injection pressures.



400 ft. per Minute *Injection Speed*

Write for catalog 5106, today.

SPECIFICATIONS MODEL 400-A					
SIZE OF DIE PLATES	SPACE BETWEEN BARS	DIE OPENS	MAXIMUM DIE SPACE	CAPACITY PER SHOT (LBS.)	NET WT. (LBS.)
38"x38"	23"x23"	16"	42"	2.2 To 12.2 (Al)*	40,000

*Note: The model 400-A handles brass and magnesium die casting as well. Complete specifications on request.

HPM

THE HYDRAULIC PRESS MFG. CO., 1094 Marion Road, Mount Gilead, Ohio

Revolutionizing Production with Hydraulics Since 1877

HYDRAULIC MACHINERY • PUMPS • VALVES • MOTORS

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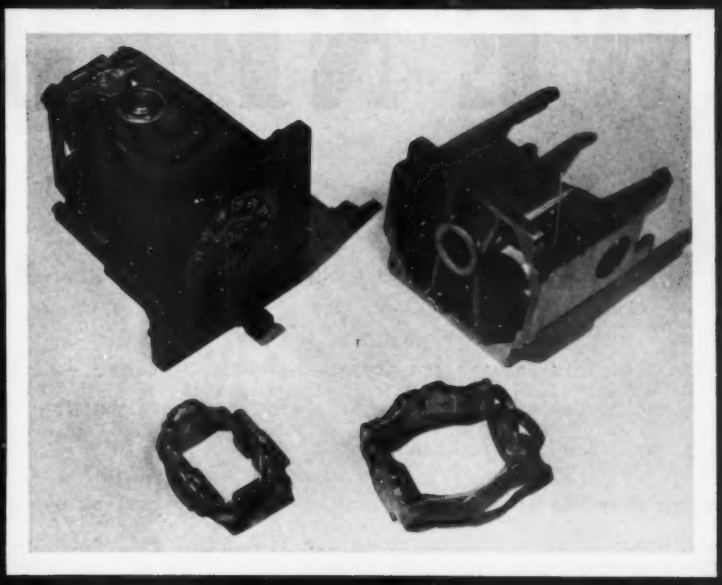
DELICATE IN DESIGN DEPENDABLE IN DUTY



Die castings contributed noteworthy advantages to this military aircraft compass.

The parts had to be rigid enough to withstand severe shock and vibration without distortion.

Uniform die castings, as produced by Pressure, met every requirement in this critical application.

Send us your inquiries.

PRESSURE CASTINGS, INC.

die castings

ZINC AND ALUMINUM ALLOYS

CLEVELAND 19, OHIO

An Open Letter to Aluminum Die Casters *from the* U. S. REDUCTION CO.

WE NEED YOUR HELP!

At the time this message was prepared – early October – aluminum scrap had become extremely scarce. We hope sincerely that by now the normal flow of scrap has resumed.

You can help the aluminum smelters as well as yourselves by doing everything in your power to see that scrap gets back to them through normal channels. Talk to your friends and customers who generate scrap in their operations and urge them to return this desperately needed scrap – all types and grades – large or small quantities – to the smelters through their regular scrap dealers.

Without scrap the smelters must continue to curtail their much needed production and you will not get the aluminum alloys you need in the quantities necessary to produce the castings required in the defense effort by your customers.

WON'T YOU HELP THE ALUMINUM SMELTERS – THE DEFENSE PROGRAM – AND YOURSELF?

USCO **U. S. REDUCTION CO.**
East Chicago, Indiana

For 47 years, pioneers in aluminum development.

PLANTS: EAST CHICAGO, INDIANA • TOLEDO, OHIO

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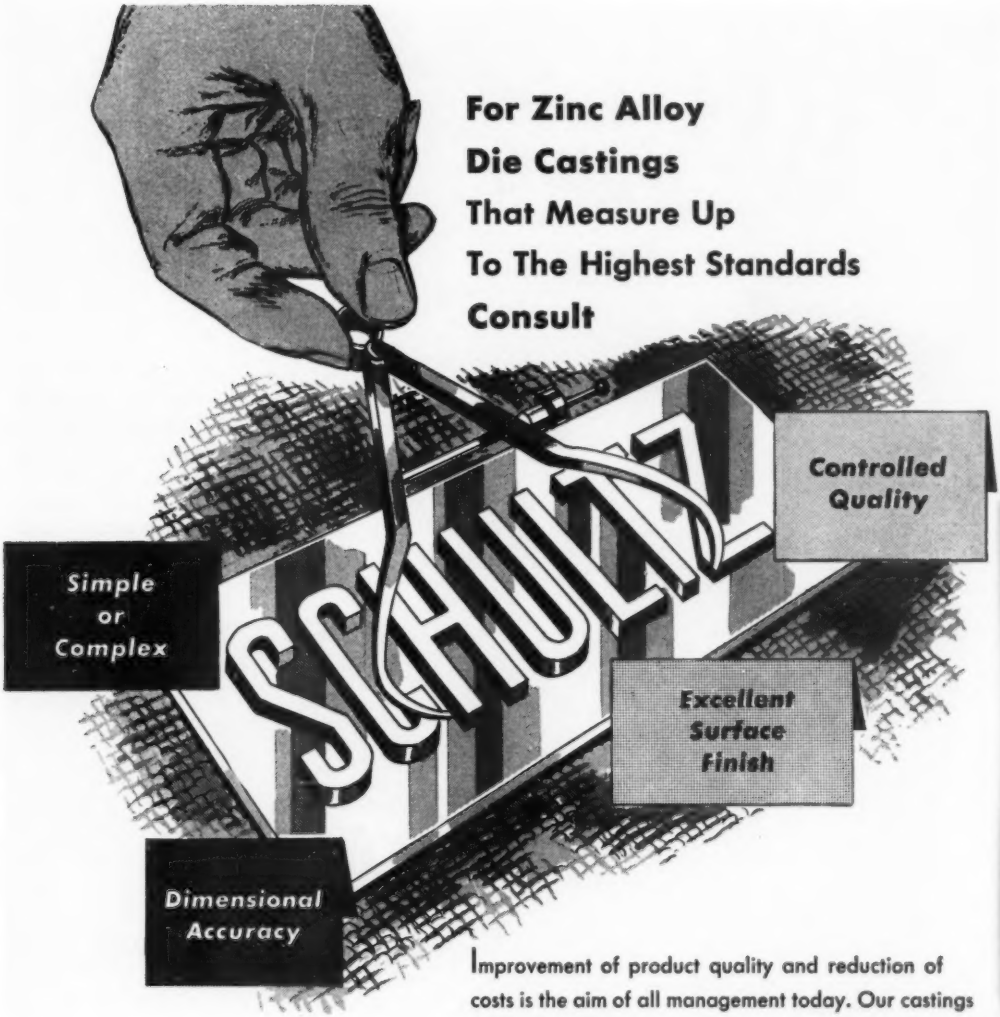
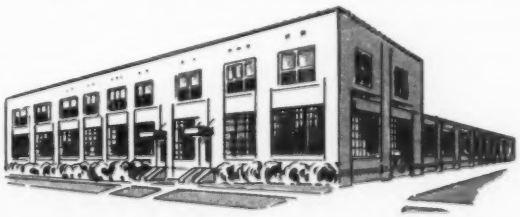


For Zinc Alloy Die Castings That Measure Up To The Highest Standards Consult

Improvement of product quality and reduction of costs is the aim of all management today. Our castings are both competitively priced and outstanding in quality, and can help you build a better product for less. May we quote on your requirements today?

Our Engineers Are At Your Service



SCHULTZ DIE CASTING COMPANY
1810 CLINTON STREET • TOLEDO 7, OHIO

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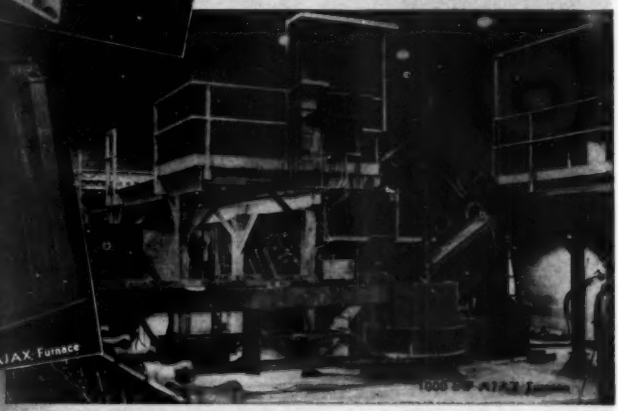
Yes! AJAX Induction Melting Furnaces are Versatile!



For many years AJAX has been the pioneer in the development of standard frequency induction furnaces for melting metals. Today this type of equipment has been adapted to the full range of non-ferrous metals and alloys and to a great variety of sizes ranging from 20 to 1000 kw.

AJAX Induction Melting Furnaces are now used for the following applications: Die Castings, Permanent Mold Castings, Sand Castings, Billets for Rolling and Extrusion, Recovery of Scrap, Galvanizing and Aluminizing of Steel and many others.

For special applications an Automatic Electromagnetic Pump allows continuous feeding of molten metal into the molds as they move past. Hand ladling is eliminated. Temperature, of course, is also automatically controlled and there is no chance of overheating the bath at any time during the melting cycle.

WRITE FOR FURTHER INFORMATION

AJAX ENGINEERING CORP., TRENTON 7, N. J.

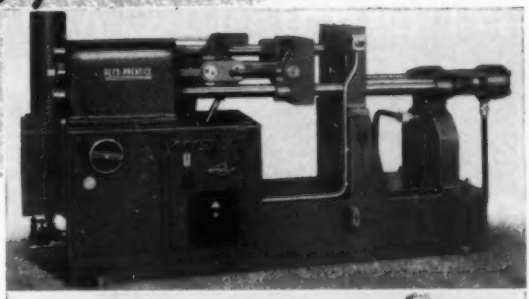
AJAX TAMA-WYATT

INDUCTION MELTING FURNACE

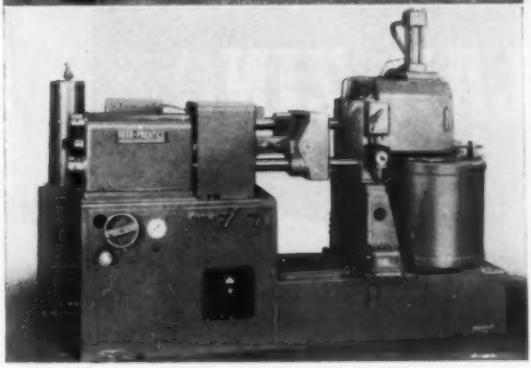
AJAX ELECTRO METALLURGICAL CORP., and Associated Companies
AJAX ELECTROTHERMIC CORP., Ajax Northrup High Frequency Induction Furnaces
AJAX ELECTRIC CO., INC., The Ajax Hultgren Electric Salt Bath Furnace
AJAX ELECTRIC FURNACE CORP., Ajax Wyatt Induction Furnaces for Melting

For additional information circle No. 8 on the Reader Service Card

LOW COST, HIGH SPEED DIE CASTING



Reed-Prentice No. 1G Die Caster for Aluminum, Magnesium and Brass Alloys



No. 1 Die Caster for Zinc, Tin & Lead Base Alloys

IMMEDIATE DELIVERY on No. 1 & No. 1G Die Casting Machines Subject to prior sale

Fast-cycling Reed-Prentice No. 1 and 1G "Combination" Die Casting Machines provide dependable, high-speed production on small parts at surprisingly low cost.
The No. 1 machine produces up to 700 shots per hour while the Model 1G "Cold Chamber" machine completes 400 cycles per hour dependent on product and die complexity.
Cold Chamber unit or Furnace attachment are readily interchangeable and may be purchased separately to keep investment cost at a minimum where but one standard machine is desired.
You can get the complete story on Reed-Prentice Die Casting Equipment by sending for Catalog No. 16. Why not write us today?

SPECIFICATIONS	#0	#1	#1G	#1½	#1½G	#2	#2G
Size of die plates (VxH)	10 x 10"	16 x 21"	16 x 21"	32 x 29"	32 x 29"	38 x 36"	38 x 36"
Diameter of tie bars	1½"	3"	3"	4"	4"	4"	4"
Space between bars (VxH)	8¼"	12"	12"	20 x 15"	20 x 15"	24 x 24"	24 x 24"
Die Opens	4"	8"	8"	10"	10"	14"	14"
Maximum die space	4"	14"	14"	23"	23"	30"	30"
Capacity per shot (Lbs.)	1-zinc	5.75-zinc	2.35-alum.	10.5-zinc	3.75-alum.	15-zinc	9-alum.
Net weight (Lbs.)	1,500	8,000	7,200	16,500	14,500	24,750	22,700

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REED-PRENTICE CORP.
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for Quality Production

AMERICAN ELECTROLYTIC

99.99+% SLAB ZINC

A reliable source for die casting requirements

AMERICAN ZINC SALES COMPANY

Distributors for

American Zinc, Lead & Smelting Company

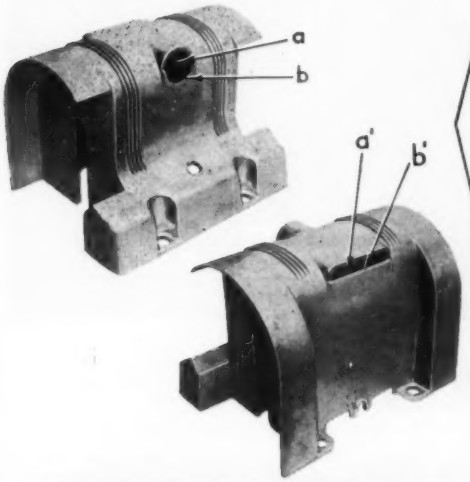
Columbus, Ohio • Chicago • St. Louis • New York

For additional information circle No. 11 on the Reader Service Card

DO's and DON'Ts in DESIGNING ZINC and ALUMINUM DIE CASTINGS

examples by DOLLIN

PRINCIPLE: Costs can often be reduced by offsetting openings so that coring can be accomplished with fixed instead of movable cores.



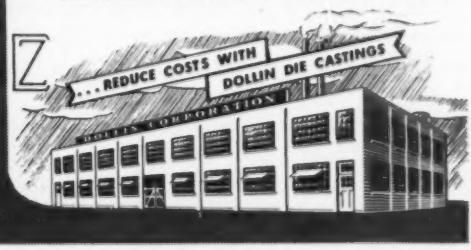
EXAMPLE: the manufacturer's original design for this bench grinder housing called for uninterrupted edges around openings **a** and **a'**. To cut die casting costs, Dollin engineers recommended incorporating steps **b** and **b'**. This eliminated the need for movable die cores—made possible coring by fixed die members. RESULT: substantial savings in production costs for the manufacturer.

Dollin engineers will work with you on design refinements, recommending whatever changes will simplify the die casting operation, improve the soundness of the castings, or eliminate machining, finishing, or assembly operations. They have at their disposal extensive, modern facilities, and are thus free to adapt designs for lowest final cost.

Dollin can efficiently produce all commercial sizes of die castings—facilities include large plunger zinc machines, large and medium size cold chamber high pressure machines, and a separate small castings department (see examples at left). Write for estimates and engineering advice, at no obligation.

SPECIAL SMALL CASTINGS DEPARTMENT
For low die and casting costs: small single or double cavity dies—high speed automatic machines.

PRIME CONTRACTORS—CHECK WITH DOLLIN FOR SUB-CONTRACTING ON DEFENSE ORDERS



DOLLIN CORPORATION
614 So. 21st St.
Irvington 11, New Jersey

SALES OFFICES: Detroit • Philadelphia • Chicago • Boston
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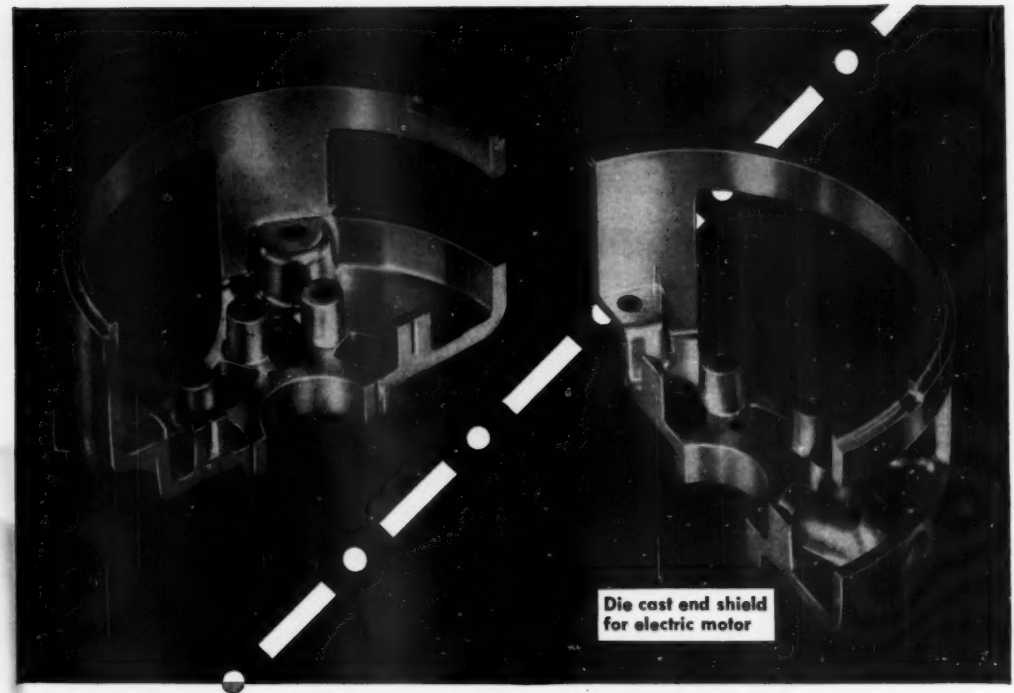


HOOVER QUALITY

Goes "All the Way Through"

Good appearance is often a *must* in the requirements of a die casting . . . but good appearance stands for little unless that casting has structural quality to back it up.

Hoover die castings, on millions of units, have made a name for Hoover . . . because Hoover has gone the limit—has "leaned over backward" —to make sure that Hoover die castings will be a credit to the good name of Hoover and the manufacturers using them.

If you use die castings, or if you are looking at the possibilities of die castings, remember these facts about Hoover service—

- Hoover has been making die castings since 1922.
- Hoover has one of the largest and most complete die casting plants in America.
- Hoover staff includes top-ranking engineers, metallurgists, skilled production craftsmen.
- Hoover equipment includes the most modern metallurgical, fluoroscopic and X-ray laboratories.
- Hoover is among the leaders in the die cast industry as well as in the electric cleaner field. Hoover knows how—and does it the quality way, from the inside out!

THE HOOVER COMPANY

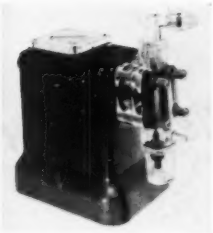
Die Castings Division, North Canton, Ohio

HOOVER

Specialists in the field of die castings

For additional information circle No. 32 on the Reader Service Card

CHEMICAL EQUIPMENT designed for high production with *Die Casting*



WHILE essentially a piece of chemical control equipment designed to sterilize the drinking water supply for farms, homes, summer camps and other small users, the Chlorinet manufactured by Wallace & Tiernan is also a specialized type of domestic appliance.

It is manufactured in relatively large quantities and sold at prices which are within the reach of individual purchasers. Although constructed by high production manufacturing techniques instead of those usually employed for the small scale output of scientific instruments, accuracy of detail and performance have not been sacrificed. The large volume of output has made possible the use of more economical manufacturing methods for obtaining the type of accurate construction usually secured in scientific apparatus by manual fabricating, hand fitting and custom machining.

The Chlorinet is designed to feed a closely controlled amount of hypochlorite solution into the water supply to sterilize it, affording small water systems the same protection against disease that cities and towns obtain from larger equipment.

Function of the Chlorinet is essentially a synchronized metering operation, and thus its mechanical construction is simple. It involves a small 30 watt electric motor, gearing, corrosion-resistant plastic pumping head and fittings and a simple knob adjustment to control amount of feed.

For durability at low cost, Wallace & Tiernan has utilized die cast aluminum parts for housings, motor mount and a yoke which is a small functioning part.

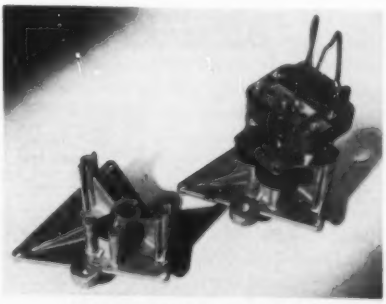
In actual practice, these units are installed to feed into the water line, plugged into an electric outlet, the adjuster knob set—and then, except for adding hypochlorite solution to the reservoir container and periodically testing the water for chlorine residual, it seldom needs attention or servicing.

The die cast housing and base which enclose the

continued on page 58

LESS EXPENSIVE THAN DEEP DRAWING

SIMPLE SHAPES FOR DIE CASTING



ACCURATE MOUNTING LOCATION

Taking advantage of the controlled porosity possible through the use of sintered metal powders, the British aircraft industry has developed two types of chemical de-icers which depend upon powder metallurgy. Believing that these developments would be of great interest to American designers concerned with similar problems of fluid distribution and control, the editors of PMM have asked two British authorities to provide this report on their work.

CONTROLLED POROSITY is utilized for fluid distribution in aircraft de-icers: an application of *Powder Metallurgy*

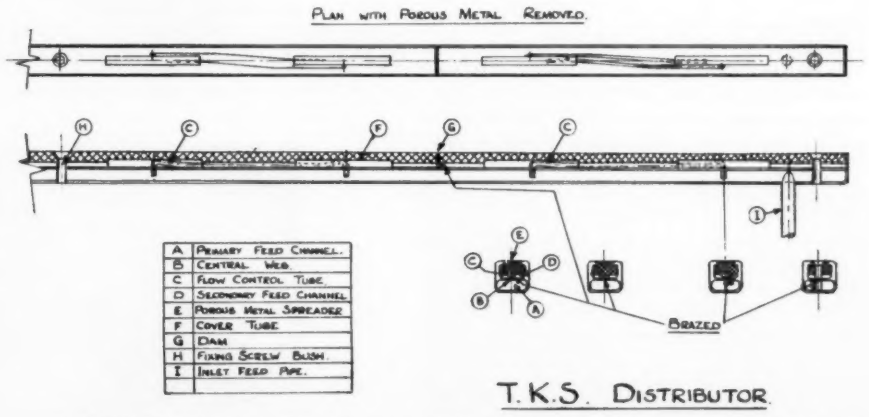
by
R. I. BLACKWELL
and
J. W. LENNOX

ICE formation on aircraft has presented a hazard which, up to the present time, has not been dealt with satisfactorily. The following article discusses the ice formation on the air frame, rather than on the engine, windscreens, etc.

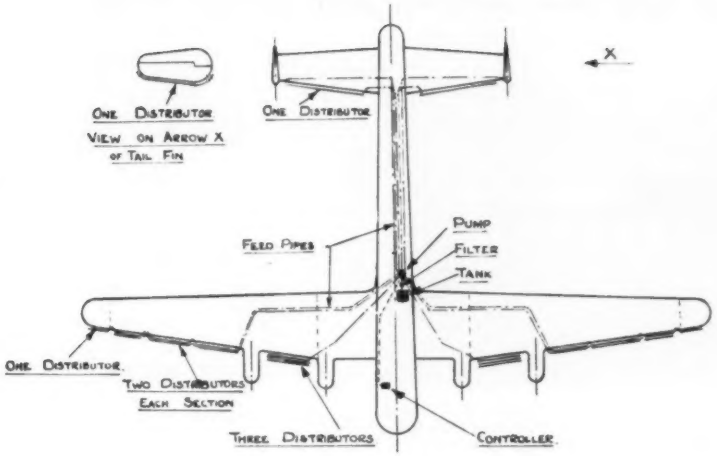
To the pilot of an aircraft, ice presents a natural hazard which must be avoided, if at all possible. The pilot from his meteorological report can anticipate where icing might occur, but experience has shown that this is not always possible.

The build-up of ice on the aircraft's wings and surfaces, if allowed to grow unchecked, can impose a serious increase in weight, bringing about a considerable reduction in air speed, and worst of all, disrupting the airflow to such an extent that the control of the aircraft may be critically affected.

As icing conditions occur in unexpected places, it is either necessary to equip the aircraft with a means of preventing dangerous ice formation, or restrict flying where icing conditions can occur.



1. DIAGRAMS showing construction of the porous metal insert distributor reveal the position of sintered fluid spreader. Construction data is presented on page 31.



2. LOCATION OF POROUS METAL DISTRIBUTORS within the stagnation area on wings, tail planes and fins is indicated by this diagram.

Three general types of icing are encountered:

HOAR FROST. When aircraft fly through filmy clouds of warm damp air; the water vapour freezes on the wings in the form of a white semi-crystalline powder. This type of freezing has no serious effect on the aircraft, and generally speaking, requires no special precautions other than its removal, prior to take off on the ground and in flight can be ignored.

RIME ICE. A more serious condition known as rime ice is found when aircraft fly through clouds of heavy super cooled water. This is formed by the direct condensation and freezing of water in the low temperature regions, and the wings rapidly build-up heavy coatings of ice. This type of ice is a heavy white opaque deposit which collects around the stagnation points of the leading edge of the wings, and on and around wires, external tanks, air intakes, coolers and similar projections. Fortunately, the rime ice is not very strong and flakes off fairly rapidly, but it is of a very dense structure and thin layers have been known to upset the stability of the aircraft.

GLAZED ICE. The most dangerous type of ice formation usually occurs when freezing rain falls upon the cold metal work of the aircraft. It is the rapid cooling of this rain that forms glazed ice. This is a heavy coating which adheres tenaciously to the surface.

When these conditions arise—and with variations in cloud temperature, they might quite easily be met by high altitude aircraft—the ice bonds at a rapid rate, sometimes as much as 3"/minute, causing the aircraft to become uncontrollable and often results in the control surfaces freezing-up. This high speed of ice formation is extremely difficult to overcome.

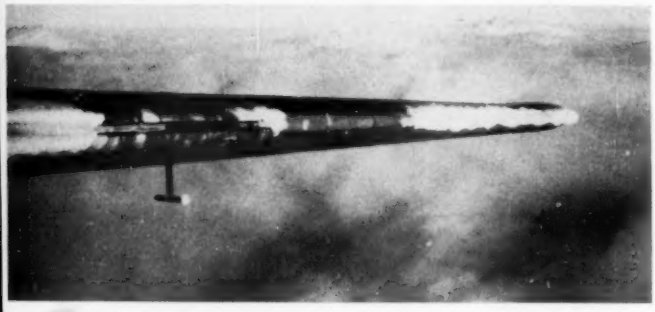
Present day methods of preventing ice on aircraft fall into three general headings:

1. HEAT. The jet engine provides sufficient waste heat to completely de-ice affected surfaces. The distribution of this heat, however, is not a simple problem, as the entire surfaces, and any areas on which melting ice can run back, must be heated. Both the initial cost and the weight penalty must be considered, as this equipment must be carried throughout the life of the aircraft.

2. MECHANICAL. The mechanical system of ice prevention is by means of a pulsating shoe which is attached to the leading edge of the aircraft. This can be attached to the aircraft after manufacture, but it has been shown that this suffers very serious disadvantages. The flexible rubber overshoe has a very high maintenance cost due to its rapid de-erioraton in use. To make this operate successfully a skilled pilot must know when exactly to switch it on; if the system is brought into operation too early the ice cracks but remains above the pulsating device, and continues to build-up. If it is switched on too late, certain types of icing will be much too firmly bonded to be removed by the device.

3. CHEMICAL. Experimental work with the use of chemical de-icing has shown that it has a number of advantages and the following report is of tests made with the use of chemical de-icing and the application

Close control of fluid flow obtained with porous metal.



3. TEST SECTION on aircraft wing is free of ice while outboard and inboard sections not treated in any way have a dangerous buildup of ice. Photo taken during flight tests in winter of 1950 show the type of conditions that occur in European flying.

of porous metal to the leading surfaces of the aircraft.

It has been stated that ice prevention by means of a fluid can only be achieved by using sufficient quantities to depress the freezing point of all the super cooled water encountered in the catchment area of the aerofoil to a point below that of the skin temperature of the aircraft. This makes it necessary to use large quantities of fluid, which is unsatisfactory both from the cost and weight point of view.

Tests have shown, however, that large flows are unnecessary, and that effective protection can be obtained by preventing the ice bonding to the aircraft by impregnating the super cooled water droplets.

The type of fluid used is of the ethylene glycol family, but has had to be modified to give a tenacious film. In the tests that have taken place to obtain this fluid, it was found that it must be entirely soluble in water and have the greatest possible ice melting properties. It must not, however, be instantaneously miscible on contact with water, the smallest quantity, 1-10,000th part will prevent the bonding of the ice.

A fluid made by the Kilfrost Manufacturing Company of England, and marketed as R.328 was developed after a considerable amount of experimental work going back to early tests in 1936. Generally speaking, super-cooled water droplets on striking the aircraft commence to turn to ice, but there is a definite time lag before they become entirely frozen. When a film of R.328 fluid is on the aerofoil, that part of the water droplet that freezes immediately on contact, absorbs sufficient R.328 to prevent bonding of the ice to the aerofoil by changing the ice formation from hard ice to one of a softer texture which has no tendency to bond.

It will be readily appreciated that this is a completely new interpretation of the action of chemical de-icing. To ensure that chemical de-icing can operate successfully, on the basis of using small quantities of fluid, it was necessary to devise a system which had very accurate control of the distribution of the fluid. The initial distributors were manufactured from various types of soft substances—leather, cotton, cotton-rubber mixtures, cotton-rubber-wire gauze mixtures, but it was found that the distribution obtained was unsatisfactory.

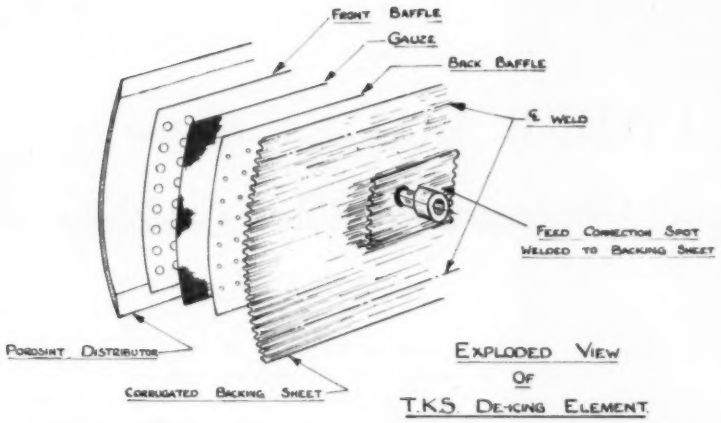
Evolution of the porous metal insert distributor

After considerable experimental work a system was devised using porous metal which gave uniform distribution of extremely minute quantities of de-icing fluid over the entire length of the air craft wings, and also for the tail plane and fins.

This is described in U. S. Patent Nos: 2.372.581 and 2.433.214, granted in 1945 and 1947. Figure 1 is a typical cross section of the de-icing distributor at present in use on the following British aircraft: Vickers (Viking, Valletta, Varsity), Avro (York, Tudor, Shackleton), De-Havilland (Hasting, Hermes, Marathon), Short (Sealand).

At the outset two main difficulties were encountered in designing the distributor. In the first place to maintain satisfactory overall distribution, secondly to manufacture a lightweight distributor sufficiently strong to withstand high pressure which is encountered in distributing de-icing fluids, caused by considerable increase in viscosity with falling temperatures.

The distributors are ½″ square in section, made up in lengths of up to 7′ 6″, inserted within the stagnation area on the wings, tail planes and fins, Figure 2, and are connected together in banks to a constant delivery pump.



4. ATOMIZED BRONZE POWDERS are used for this later development of the "Porosint" lamina distributor. Millions of minute pores in the powdered metal panels allow the de-icing fluid to exude at a controlled rate.

Constructional data of the insert distributor

The basic component of the distributor is a square section Monel tube rolled from round seamless tubing to a shape that constitutes closed rectangular channel at the back and a 'U' shaped channel in the front with two lips to assist in the retention of the porous metal. A cavity is formed between the back face of the porous metal and the centre web, Figure 1.

The back channel is connected to the reservoir behind the porous metal every 3 inches along the length of the distributor by tubes brazed into the centre web. These tubes vary in length from 2"-3½" and have a bore of .015" to .018". They are bent so as to be in the cavity between the web and the porous metal and are protected from the ingress of dirt by close fitting cover tubes.

Dams made of thin strip are positioned at 12" intervals between the porous metal and the web, closing the cavity and partitioning the secondary channel into chambers each 12" long.

In the center of each of these chambers is placed one tubular ferrule which passes completely through the distributor. The function of these ferrules is to allow entry of the fixing screws when the distributor is placed in position on the aircraft.

The distributor is required to perform three main functions:—

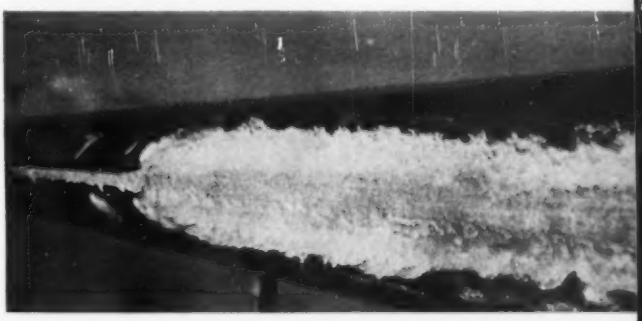
a) To feed the liquid along the leading edges.
b) To meter the flow of liquid so that the correct quantity can be delivered at any point on the aerofoil.
c) To complete spreading of the liquid evenly on the leading edge.

These duties are performed as follows: The back channels of one or more distributors are connected to one pump outlet, calibrated to deliver the correct quantity of de-icing fluid required by the aerofoil served by these distributors. The liquid is fed along this back or primary channel. Every 3" along the length there is an outlet, into the secondary channel behind the porous metal. The capillary tube measures the volume of liquid flowing into the secondary channel to the exact amount required at any particular point on the aerofoil.

The outer half of the secondary channel is filled with porous metal and the liquid seeps through this on

continued on page 65

5. MORE THAN 50 percent saving on de-icing fluid was reported as the result of flight tests using "Porosint" panels which obtained "equal if not slightly better results" on half of the flow rate of standard inserts.



FLEXURE UNDER LOAD is overcome with a rigid frame by *Permanent Mold Casting*

By BRUCE ADAMS
President
Pelouze Manufacturing Co.

FLEXURE AND FRICTION are bugbears in the design of small scales. They result in inaccuracies in weighing and contribute to the deterioration of the scales in service.

Conventional stamped sheet metal housings cannot readily be prevented from yield under loading. Neither is it possible to avoid distortion, bending or warping of a stamped frame from normal abuse and handling.

To overcome these undesirable conditions, the Pelouze Manufacturing Company three years ago set out to redesign their line of household, postal, dietetic and other small scales. Since the turn of the century, these hinge-action scales had been constructed with stamped shell and base.

The Pelouze scales have a circular dial with center pointer driven through a rack and pinion, rather than direct linkage. The two hinged levers connect the lower extension of the platform to the frame.

In the first attempt to get rigidity, a gray iron casting was tried, but the problems of warpage and excessive machining ruled out this method.

Subsequently, experiments were conducted involving formed steel channels to stiffen the chassis, and construction was tried with the levers hinged to the stamped shell. These attempts failed to give the desired rigidity, and later attempts to hinge the levers directly to the channels were likewise unsatisfactory.

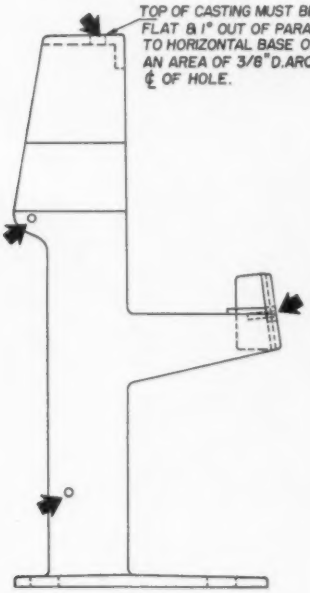
At the same time, steps were taken to dress up the scales, to give them a clean, modern appearance and improve the sanitary aspects of these scales which are often used in kitchens and hospitals.

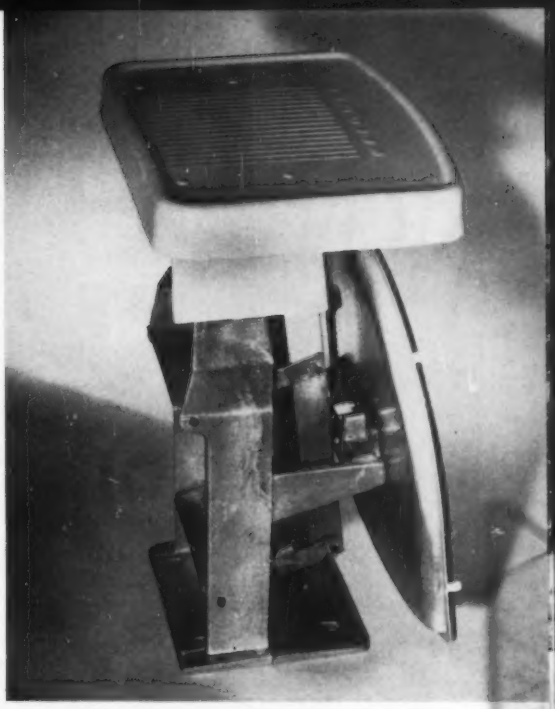
The Chicago design firm of Palma-Knapp Associates was called in to work out all the above stated problems in cooperation with the Pelouze engineering department.

One-piece frame . . . .

. . . . replaces stamped assembly.

The basic problem: a rigid frame to connect six points





MINOR DESIGN CHANGES have brought about a reduction of 14 percent in the cost of this frame casting since production was started. Drawing at **left** indicates critical points which must be held in close relative position under load.

The designers evolved an outer shell for the scales molded of a shock resistant plastic, produced in different colors. Ease of cleaning was a keynote in exterior design.

Within this plastic housing, attempts were then made to develop a metal frame which would have adequate rigidity for the accurate operation of the scales. Fabricated construction consisting of 1/8-inch sheet steel mounted onto formed angles was introduced, but flexure still was higher than desired.

The problem was finally stated in its simplest form: There are six essential points which must be accurately located and held in relation to each other. The inner chassis must be a one-piece frame, capable of sustaining these relationships under load, after aging and ordinary abuse.

These six points include the four pivot holes for hinge pins, the pinion shaft hole, and the anchor point for the coil spring. The obvious fabrication method for a one-piece frame to tie together these six points is some type of casting: it remained to select the most suitable casting method.

Permanent mold casting in aluminum offered close enough accuracy and a good combination of strength and aging characteristics. Relatively low initial tooling cost was another desirable factor.

Elimination of all but one machining operation, and the use of self-tapping screws in holes cored in accurate location, cut down on expensive secondary operations.

Harris Metals Treating Company of Racine produces the castings in a secondary aluminum alloy by the Wessel method which involves the use of vacuum during casting to permit thinner section and greater complexity of shape.

Although some flow marks occur, and a relatively large gate leaves a mark, surface finish is not important because the molded chassis is completely enclosed in the plastic case. Strength and stability are the two essentials.

There are few tolerances in the chassis closer than normal commercial casting practice. One of these close dimensions is .556-.558 on the distance between the center of the pinion shaft hole and the boss against which the rack rides. The reason for this close dimensional relationship is apparent.

All holes are cored, with core pins pulled from five surfaces. These include not only the four small hinge

continued on page 62

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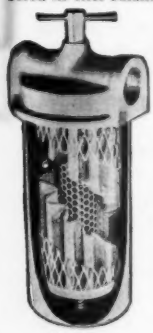

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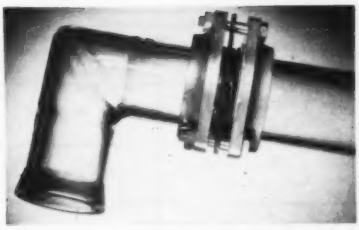
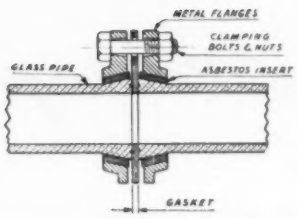
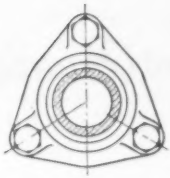






TIGHT FITTINGS for glass pipe by *Die Casting*

PYREX glass pipe has many advantages for the chemical, food processing and wine industries because of its ease of cleaning, toughness, resistance to corrosion and visibility for constant check on color and condition of liquids.

However, it is not possible to obtain tight joints with this type of heat and corrosion resist glass pipe by the same type of fittings as used for threaded metal pipes, and so Corning Glass Works, producers of Pyrex glass pipe and other industrial and domestic Pyrex products, have developed a special system of flanges and gaskets which give a completely tight joint between glass pipe sections.

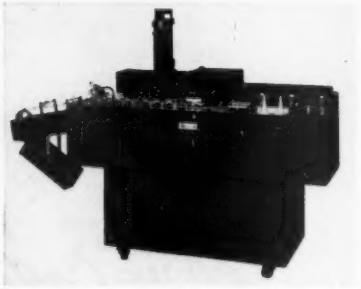
For 1", 1½" and 2" Pyrex pipe, die cast aluminum flanges have been utilized, as illustrated. Corning engineers like die cast flanges because they save considerable machining cost, and because they are neat, clean and strong.

Appearance is important because this piping is often used in dairies and food plants where clean, smooth surfaces and pleasing appearance are desired.

Pyrex glass piping is used in the transportation of corrosive chemicals, as well as milk, foods and wine. It withstands high temperatures and pressures and it can be installed by pipe fitters or mechanics without specialized training.

Closeup view shows the simplicity of installation, while the section view shows details of flanges, gasket, clamping bolts and asbestos insert used to make a tight joint.

SAVINGS UP TO 84 PERCENT on gears, pawls and special shapes by *Investment Casting* and *Powder Metallurgy*



THE place of die castings in the construction of business machines has become well established over a period of years. The use of die cast parts where sufficient volume is required, is almost standard practice for such elements as side frames, brackets, housings, small functioning parts, decorative trim, levers and knobs.

At Addressograph-Multigraph Corp., die cast parts have been employed successfully for many years. More recently, however, two additional types of molded metal parts have also found their way into the company's machines.

An increasing number of parts are now being designed for production by powder metallurgy and investment casting. Principally, they have replaced machined parts or fabricated assemblies on the basis of cost and performance.

While it is true that in the field of addressing and duplicating machinery, the high volume production that is characteristic of typewriters and adding machines is not present, engineers at Addressograph have been able, by standardizing parts among various models, to achieve sufficient volume for some parts to make these newer, high production processes attractive.

Powder metal gear and ratchet unit is hardened and brazed

The feed table raising mechanism on several models of the Multigraph is an assembly where standardization of parts has allowed the use of powder metallurgy as a fabricating method for several parts.

The ratchet and gear for the elevating table are an example of these parts. The former method of manufacture was to machine three parts from bar stock and

	PART	OLD METHOD	NEW METHOD	SAVING
1	Ratchet & Gear	3 parts machined from bar & brazed	2 METAL POWDER parts hardened & brazed	51%
2	Idler Gear	2 parts machined from bar & brazed	Molded from copper-iron METAL POWDER	66%
3	Miter & Spur Gear	2 parts machined from bar & brazed	Molded from copper-iron METAL POWDER	82%
4	Latch Pawl	Machined from bar	INVESTMENT CAST in SAE 1117 steel	84%
5	Blate Feed Pawl	———	INVESTMENT CAST to save punching tools	——
6	Selector Drum	———	METAL POWDER part to save machining	——
7	Selector Plunger	2 parts machined from bar & brazed	INVESTMENT CAST in SAE 1117 steel	21%

assemble them by brazing. Through the use of metal powder molding methods, the assembly has been reduced to two pieces, brazed together, Figure 1.

A very few years ago, the idea of making hardened steel parts from iron powder was limited to the rather nebulous dreams of a few research and development workers. Today, that procedure has become a standard one in the powder industry and, as in this case, hardening up to Rockwell "C" of 50 is routine.

In addition to the hardening of this piece, there are a few dimensions that are held excessively close. The bore is .6875 ± .0005, an unusual requirement, and the pitch diameter of the spur gear is held to + .000 — .003 on a diameter of 2.623.

Not only has powder metallurgy met all of these requirements, but has done so at a saving of 51 percent in manufacturing costs.

Two other parts of the paper feed table raising mechanism that are of particular interest are the two gears shown in Figures 2 and 3. Both of these gears, and the gear-ratchet assembly just described, are made by the Powdered Metal Products Corp.

These two gears, as contrasted with the part previously described, have no particular hardness requirements. Both pieces are made to rather normal tolerances for the powder industry and are an iron-copper mixture.

In both cases, however, the substitution of a single piece made from metal powders has replaced an assembly of two parts machined from bar and brazed together.

The change to powder metal parts has resulted in outstanding cost reductions: 66 percent in the case of the idler gear and 82 percent in the case of the miter and spur gear.

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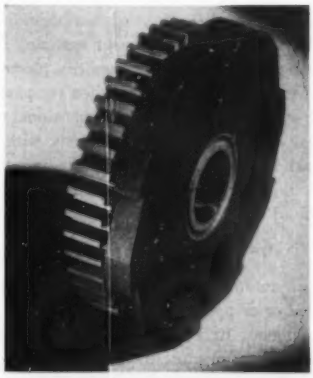
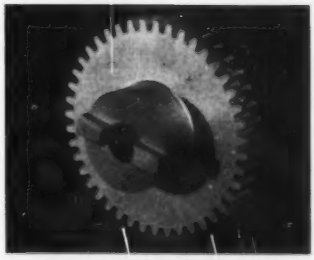
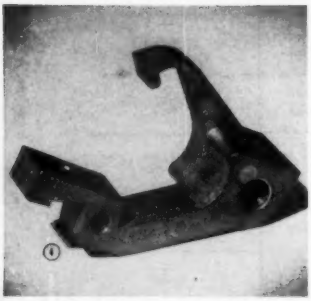
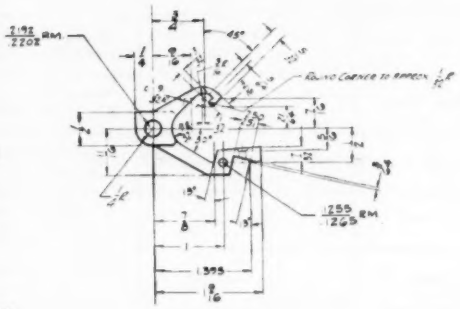




Investment Casting simplifies production of complex machine parts





CLOSE DIMENSIONS PLUS DIFFICULT SHAPES

The latch pawl used on the Addressograph is an excellent example of simplification of manufacturing made possible by the use of investment castings. Not only does the complexity of the piece require a phenomenal number of machining operations when the part is made from bar stock, but some of the dimensional tolerances are such that to attain them directly without secondary operations appears almost an impossibility.

Nevertheless, this part shown in Figure 4 is being regularly made of SAE 1117 steel by the Midwest Precision Casting Co.

This piece is a functional element of the selector mechanism which automatically selects the plates which are to be printed or skipped.

As further evidence of the savings made possible through the use of investment casting, the change from machining to casting has saved 84 percent.

Another investment casting of interest is the pawl for the Addressograph. This pawl, Figure 5, would appear to be a typical punch press part. Probably this method of manufacture would be used if the number of parts involved were larger. In this particular case, however, the cost of blanking and shaving dies to give the required dimensional accuracy was high enough to make investment casting the more economical method.

As cast by the Perrier Co., the pawl is furnished completely finished except for the slot which is milled by the user.

Consider also the selector drum and plunger. These two parts, along with the latch pawl shown in Figure 4, are a portion of the mechanism which automatically selects the plates to be printed or skipped. This function is one which must operate smoothly, uniformly and with freedom from errors.

Manufacturing tolerances must be close if the part is to fulfill its functions and, at the same time, must be susceptible to low cost manufacture since it is used on most models of the Addressograph.

The drum itself, Figure 6, is made from bronze powders by the Keystone Carbon Co. This part is over 90 percent of theoretical density and many critical dimensions are held to a tolerance of ± .001. This close dimensioning is maintained on the outside diameter of nearly 2½ inches.

The slots on the outer circumference are called out at 0.251 + .001 — .000. This particular slot is noted because the slide which fits into it is formed by another PMM process, investment casting, where equally tough tolerances are demanded as described below.

The bronze selector drum is received from the fab-

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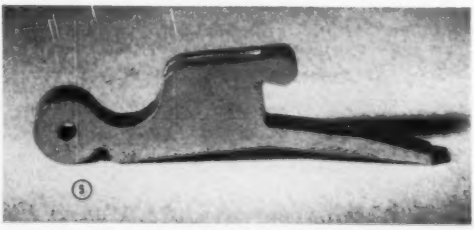
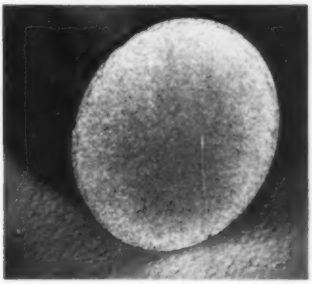
INVESTMENT CASTING SAVES DIE COSTS





STAINLESS STEEL FILTER with high strength produced by *Powder Metallurgy*

SINTERED STAINLESS STEEL forms the explosion-proof screen of the Staticator, a unit which detects the presence of static electricity in areas where there is an explosion hazard. This screen is made of near spherical stainless steel particles, sintered to give a highly porous structure with high strength.

The Staticator is a portable instrument manufactured by the W. E. Anderson Company of Kansas City, Mo. It provides a warning to indicate the presence or buildup of a static charge.

The stainless steel screen is circular in shape and is mounted in the aluminum casting which forms the instrument housing by pouring molten aluminum around it. Porous character of the screen creates a mechanical bond with the aluminum at the outer quarter inch of the disc's circumference.

Stainless steel was picked for this application for its strength as well as its corrosion resistance in the presence of most chemical vapors likely to be encountered in industrial plants.

The production of filters from metallic powder materials is not new, because gas, oil and air filters have frequently been fabricated by this method. Spherical particles are desirable for this application because of the increase in porosity in the sintered mass, as compared with compacts made up from irregularly shaped particles.

Fine wire mesh might have been less expensive if it could be used, but it is not approved by Underwriters' Laboratories because it will not contain an explosion where internal pressure is involved. Underwriters require that an explosion-proof enclosure must stand at least four times the maximum explosion pressure that can be produced inside the case. In this instance, the porous metal disc has to withstand 480 psi. The exposed area of the disc is about 1½ inches in diameter.

The filters are formed of carefully graded stainless steel powders by Micro Metallic Corporation, Brooklyn, N. Y.

FRICTION OR BEARING SURFACES

by *Powder Metallurgy* and *Die Casting*

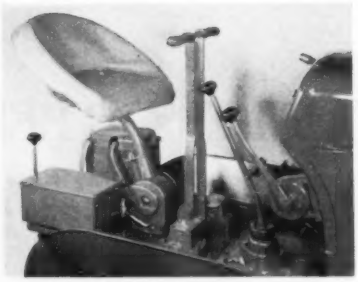
By H. W. BROCK
Chief Engineer, The Oliver Corp.

THE Oliver Corp., fourth largest maker of crawler type tractors in the United States, designs for maximum draw-bar pull per horsepower.

In order to achieve this objective, tractors are designed for maximum weight to prevent slippage of the tracks. This design philosophy allows the use of heavy gray iron castings in places where other motive equipment would use far lighter weight components.

Achievement of mass, however, cannot be allowed to interfere with proper operation, nor can it always determine material choice where the mere acquisition of weight would be uneconomical for manufacturing.

Thus, wherever manufacturing economies or specific properties dictate, PMM parts find their applications. Die castings, permanent mold castings and molded powder parts all go into the manufacture of even the largest tractors and earth moving equipment.



1. WEIGHT IS DESIRABLE but small parts can be made in light metals to cut costs.

Die cast bushing in experimental alloy cuts 35 cents from cost

2. DIE CAST ALUMINUM-TIN BUSHING

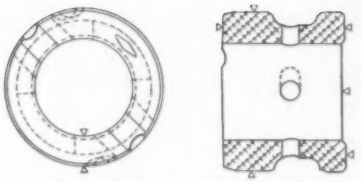
The die cast bushing shown in Figure 2 represents a part where manufacturing economy was the sole dictator of material and method choice.

This part is the front wheel and lower track wheel bearing. It replaces two parts in the earlier assembly, a cast iron bushing and a steel backed bronze bearing. Through the use of a die casting, a saving of approximately 35 cents per bearing was achieved. This saving on each bearing (there are 16 per tractor) includes both cost reduction in the part itself and a time saving in assembly.

As delivered to the Oliver Corp. by the Aluminum Co. of America, the bearing need only have the surface finishing operations indicated in Figure 3 made before assembly. Design of the piece is such that the required interference for pressing the bushing into the housing is easily and cheaply achieved.

No separate bearing is required since the particular alloy used, an experimental aluminum-tin alloy, is, in itself, a satisfactory bearing material.

The die cast housing for the throttle control clutch shown in Figures 4 and 5 has several unusual features. Normally a die caster does not find it feasible to work to tolerances less than ± 0.003 inches per inch. In



3. MACHINING OPERATIONS on bushing are indicated on the drawing.

Tapping is the only machining on die cast housing; close concentricity is maintained.

the case of this housing, on a diameter of over four inches a dimensional variation of only ± 0.0005 is held. In both the cover and the body of the housing, the center holes are held to drawing dimensions and the concentricity requirement is consistently met.

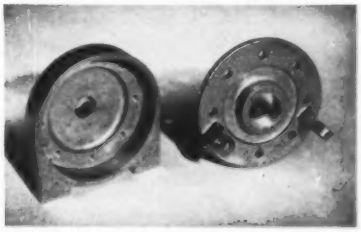
It is interesting to note also concentricity specifications between two stationary cores located in opposite halves of the die. Concentricity between the bore and pilot diameters is held within .003 total indicator reading. This is closer than ordinary commercial tolerances between points in one half of the die.

Because of the nature of the part, the cover plate must be rotatable to allow a maximum amount of flexibility in positioning the throttle handle. The ring of holes used to fasten the cover to the body are sufficently accurate so that no indexing is necessary.

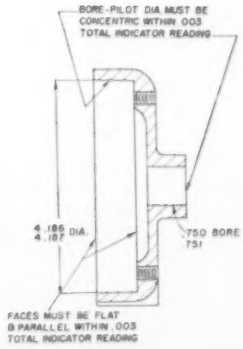
As delivered by the die caster, the Thompson Products Co., the only operation necessary on this housing is to tap holes as indicated.

Probably no other fabricating method could make this housing to the required accuracy at as low cost as die casting.

There are, normally, only two reasons for using powder metallurgy as a manufacturing technique,



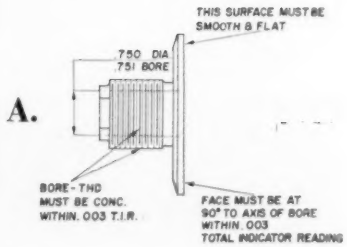
4. DIE CAST THROTTLE HOUSING.

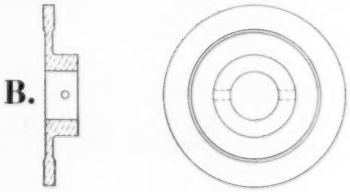

BORE-PILOT DIA MUST BE CONCENTRIC WITHIN .003 TOTAL INDICATOR READING
4.186 DIA. 4.187
.750 BORE .751
FACES MUST BE FLAT & PARALLEL WITHIN .003 TOTAL INDICATOR READING

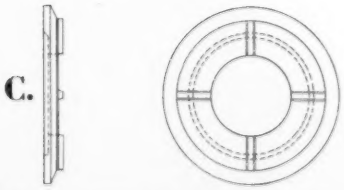
5. CLOSE TOLERANCES ARE HELD between two halves of the die.

continued on next page

Friction material for clutch formed by powder metallurgy


A.
THIS SURFACE MUST BE SMOOTH & FLAT
.750 DIA
.751 BORE
BORE - THD MUST BE CONC. WITHIN .003 T.I.R.
FACE MUST BE AT 90° TO AXIS OF BORE WITHIN .003 TOTAL INDICATOR READING





6. POROSITY OF BRONZE FRICTION PLATE (B) is about 30 percent; two copper-iron discs (A,C) run about 15 percent porosity.

lower cost or properties that cannot be secured in any other manner. The discs for the friction clutch throttle control shown in Figure 6, made by the Wel-Met Co., are excellent examples of both these reasons.

The friction plate, Figure 6B, is a special bronze containing about 3 percent silica, 3 percent graphite and 3 percent molybdenum sulfide. The copper and tin making up the balance are a 90/10 ratio. This friction mixture is specifically compounded to work against an iron plate and has a final porosity of about 30 percent.

From the composition it is at once clear that powder metallurgy is the only fabricating method that can be used to make parts from such a mixture.

The only machining operation by Oliver Corp. is to drill a .1405 diameter hole in the hub.

The fixed pressure plate, Figure 6C, is made of a copper iron mixture (10 percent copper, 90 percent iron). This plate carries tangs to engage a Belleville spring for loading the clutch to overcome the governor spring load.

Other methods of manufacturing could, of course, be used to make this part such as casting or forging followed by machining. As made from powders, however, the plate is delivered ready for assembly at a fraction of the cost of a plate made by any other method.

The adjustable pressure plate, Figure 6A, is of the same composition as the fixed plate. Here again, the use of powder metallurgy was dictated by lower cost manufacturing. After molding, only the threads and

continued on page 64

FINISHING SECTION

MACHINING—Most precision metal molded parts require some machining operations. In this section will be found information to aid in planning and selecting the proper methods and equipment for these operations.

ASSEMBLING—Precision metal molded parts are generally components of assemblies. This section includes information on fastenings and methods for mass production assembly operations.

SURFACE FINISHING—Many precision metal molded parts receive some type of surface finish such as plating, organic coating, anodic coating or chemical coating. This section includes information on the methods, processes and equipment used for these surface treatments.

A Section Devoted To the Finishing Of

Die Castings
Investment Castings
Powder Metal Parts
Permanent Mold Castings
Plaster Mold Castings

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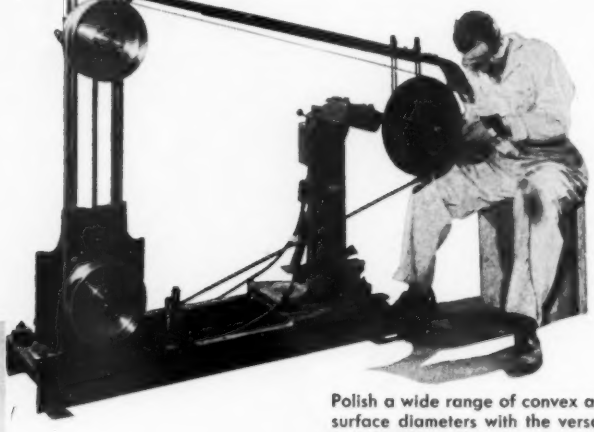

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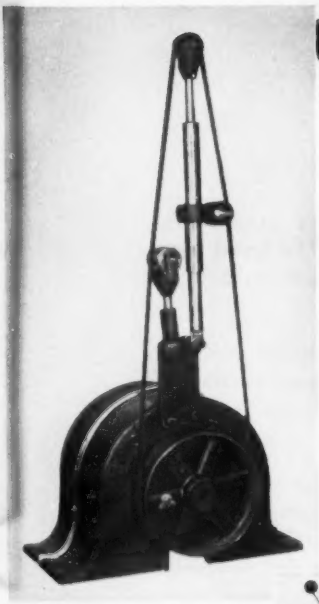

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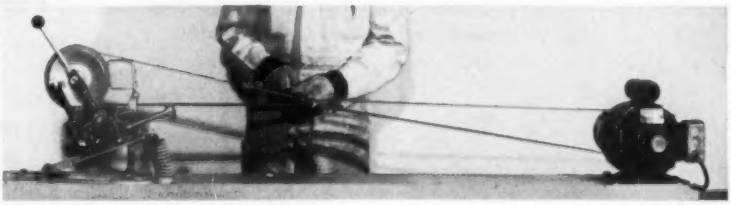
Polish small inside surfaces with the Belt Strapping Unit.



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INSPECTION OF INVESTMENT CASTINGS

utilizes X-ray equipment to check soundness

THE use of X-ray equipment for inspection is standard practice in the metal working industries. For the examination of welds, forgings and castings, X-ray inspection is almost the only tool that can be used for non-destructive inspection.

In the investment casting field, the use of X-rays for routine inspection has been applied by Arwood Precision Casting Co. where this type of examination is considered a necessity. Much of their work is for the armed forces where the specifications call for as much as 100 percent X-raying for soundness. From this high, the routine inspection may go down to as low as 25 percent of the parts checked to maintain proper quality control in the foundry.

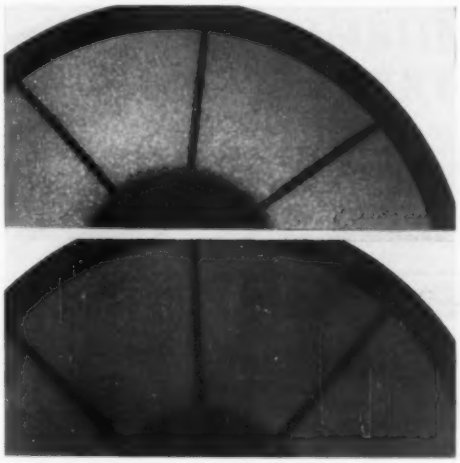
In the main plant in Brooklyn, N. Y., Arwood has installed a 220 kilovolt Picker machine that is capable of penetrating any section thickness that they may have occasion to cast by the investment process. This unit will pick out such flaws as excessive shrinkage and piping, macro inclusions, cracks, blow holes and porosity due to entrapped gases. In the hands of a skilled operator and interpreter all of the defects noted above are readily detected.

The use of X-rays for determining soundness must, however, be used with consummate skill and knowledge. Certain types of metal, notably beryllium copper, tend to give a mottled X-ray pattern that to the uninitiated would seem to indicate an extremely porous casting. The cause of this mottling is not definitely known, but is presumed to be beryllium oxide very finely dispersed through the casting.

The presence of this oxide seldom has any deleterious effect on the performance of the piece. As the degree of mottling increases a point is reached where the physical properties of the castings are materially harmed. This changeable effect is noted to point up the need of highly skilled technicians to read the X-ray films.

The accompanying X-ograms are some that show typical faults found by X-ray examination. It should be noted that much detail is lost in the reproduction of these pictures from the original negative so that not all of detail originally disclosed is apparent in the pictures.

As is common in all X-ray examination, standard penetrometers are used



GAS POROSITY is revealed in top X-ray of an investment casting. After correct foundry routine for this piece was established, gas porosity was eliminated, as illustrated in lower view. During early production, X-ray gives valuable guidance in setting up gating and foundry practice.

for determining and judging exposure. At Arwood, all penetrometers are investment cast out of the same metal or alloy as is to be examined. This procedure insures proper reading of the negatives.

Earlier, mention was made of the use of X-rays in quality control. At the start of any long run the castings are subjected to 100 percent examination. This inspection is utilized to set up proper foundry practice. As soon as the foundry is operating at a level where not more than 3 to 5 percent of the castings are rejected, the frequency of examination is reducted to about 25 percent of the parts made. Any change which indicates an increase in rejects automatically calls for more inspection until the source of rejects is corrected.

While X-ray examination is one of the basic tools of inspection, it is obvious that it is not an end in itself, other testing and inspection must dovetail into it.

In some cases, customer requirements specify grain size and micro structure of the castings. When this is the case, a careful metallographic examination is made of the castings. As in the case of X-ray examination, the amount of metallographic examination varies depending on the needs. The microscope as an inspection tool gives much needed information, but since it is a destructive method of testing, can only be used for spot checking. Once good foundry practice is established metallographic examination is used only as an occasional check.

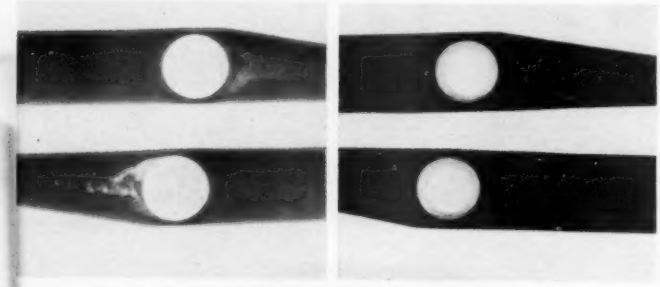
Another use made of metallographic examination is to supplement X-ray examination. When there is any doubt as to the correct interpretation of an X-ray negative, the part being examined is sectioned and studied under a microscope. The case of beryllium copper is, again, a good example of the necessity of supplementing one inspection method with another. Where there is a particularly heavy dispersion of included particles in the casting, micro cracking may often arise. Obviously, these cracks will not show up on an X-ray, but metallographic examination reveals them immediately.

In addition to the X-ray and metallographic examinations mentioned, the composition of the metal or alloy must be carefully controlled. In the investment casting field, a heat of metal may be only 50 or 60 pounds. Despite this small size, every heat of metal is analyzed. Generally coupons are made at the time the castings are poured. No castings are permitted to leave the foundry until a certified analysis is received from the laboratory indicating that the analysis of the metal meets specifications. If required, copies of these certified analyses are furnished to the customer.

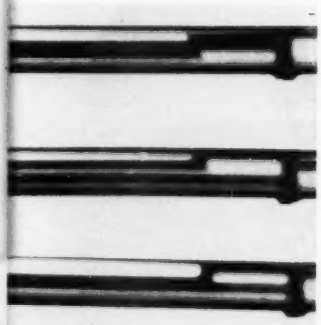
Physical tests to determine tensile properties, hardness, etc. are another routine test carried on by the inspection department. Along with the castings, standard ASTM test bars are cast and pulled to check the physical properties of the castings. As in the case of chemical analysis, either certified test results or standard test bars are furnished to the customer whenever they are required.

From the above, it can be seen that the amount and type of inspection done by the investment casters is parallel to that done by the rest of the foundry industry in general.

No mention has been made of the inspection required to meet drawing specifications. Because of the "precision" that is characteristic of this industry, those inspection methods more nearly approach the ones used in the machine shop rather than the foundry. Operating as they do to tolerances as small as $\pm.001$, it is understandable that inspection methods for dimensional accuracy must be extremely precise.



SHRINKAGE DEFECTS due to incorrect gating can be seen, **above left**, and then, after corrections have been introduced, the X-ray reveals a sound casting structure, **above right.**



CRACKING is another common foundry defect to be overcome. A typical crack in a hollow, tubular casting can be seen in the X-ray, **left center**, and after corrective action, at **lower left.**

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continued from page 10

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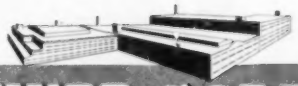

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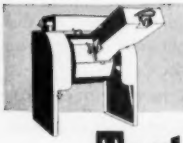

BARREL FINISHING NEWS

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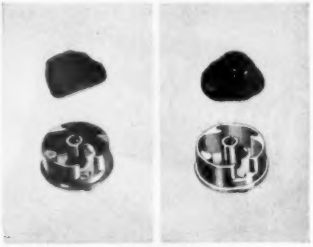

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FORM NEW EXPORT COMPANY

The Norton Company of Worcester, Mass., and Behr-Manning Corporation of Troy, N. Y., have announced the formation of a new company to handle all of the export business and direct the subsidiary operations of these two corporations throughout the world. To be known as Norton-Behr-Manning Overseas, Incorporated it will have its headquarters at Worcester. Norton Company manufactures grinding wheels and abrasive products, and Behr-Manning, a subsidiary of Norton, specializes in coated abrasive products.

BARREL FINISHING OMISSIONS NOTED

Through an unfortunate oversight, the name of the American Plating Rack Company, 232 N. Rosemary St., Inkster, Mich., was omitted from the directory of barrel finishing materials and equipment suppliers contained in the May issue of DIE CASTINGS magazine. The directory contains a complete survey of barrel finishing techniques and equipment for finishing die cast parts.

American Plating Rack Company reports ten years of practical experience in barrel finishing, including the manufacture of a portable bench type tilting barrel.

WEL-MET BUILDS PLANT TO PRODUCE POWDER PARTS

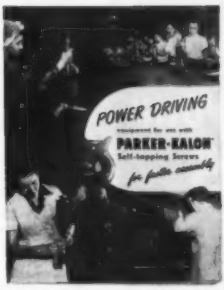
To handle the increased volume of sales, the Wel-Met Company of Kent, Ohio, has started construction of a second plant at Salem, Indiana. Contracts were signed in mid-summer, construction begun at once and it is expected that the new plant will be in operation by January 1.

According to Thomas L. Robinson, Wel-Met president, the new plant will cost upwards of a half-million dollars, exclusive of land and building, and will triple Wel-Met's production of self-lubricating bearings and structural and mechanical parts made of sintered metal powder.

KUHLMAN REBUILDS PLANT

Kuhlman Die Casting Company of Kansas City, Mo., which was burned out of its plant at 4111 East 24th St. in a fire last July, has now completed construction of a new plant at 17th and Crystal Sts.

NEW P-K Bulletin tells how to add more speed to the faster fastening method



Describes and illustrates the various basic types of electric, air-operated and impact tools, as well as the automatic hopper-fed machines for screw driving in common use. Helps you determine which type is best for your assemblies. Also includes useful information on proper bit and socket selection. Free on request.

POWER DRIVING

of P-K Self-tapping Screws

This automatic, double spindle, hopper-fed machine is being used for driving two P-K Type U Hardened Metallic Drive Screws simultaneously in a plastic wiring device.

To meet America's colossal production requirements . . . for defense, for civilian goods . . . even more speed is needed in operations that have already set time-saving records.

Fitting right into this urgent need for *more speed, more efficiency*—in assembly operations—is the ever-wider use of Power Driving devices with P-K Screws.

A wide range of Power Driving equipment is available for use with the various types of P-K fasteners—and with slotted, Phillips recessed, and hex head styles. And all types have this in common—a substantial reduction in assembly time and cost.

Parker-Kalon does not manufacture power-driving equipment, but has tested many devices in the P-K laboratory under production line conditions, and found them suitable for use with P-K Screws. The information contained in the "Power Driving" Bulletin is based on reports of these many tests.

For specific information on power driving applied to your assemblies, talk to a P-K Assembly Engineer. Your P-K Distributor will furnish a copy of the Power Driving Bulletin . . . ask for Form No. 401. Or write: Parker-Kalon Corporation, 200 Varick St., New York 14.

IF IT'S P-K IT'S O.K.

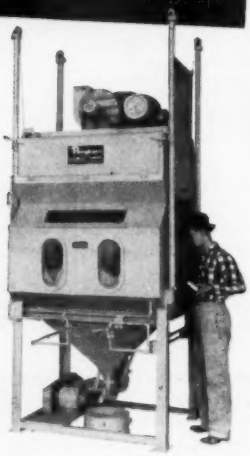
The Original

PARKER-KALON® SELF-TAPPING SCREWS

A TYPE AND SIZE FOR EVERY METAL AND PLASTIC ASSEMBLY

For additional information circle No. 57 on the Reader Service Card

Prolong the life of your DIES with PANGBORN Hydro-Finish!



PANGBORN Hydro-Finish prolongs life of expensive Tools and Dies by cleaning and polishing to a precision tolerance of .0001". Jobs that formerly took hours are done *in minutes* with *Hydro-Finish!* Fine mesh abrasives are used to clean and improve surface of die casting dies, rubber and glass molds, forging dies, and deep drawing dies, without excessive metal removal.

Dies are clean, rapidly produce hardware finish and give maximum production without expensive hand maintenance! One man alone can operate a Pangborn Hydro-Finish machine.

PANGBORNITE — The best abrasive for all liquid blasting needs. Available in many mesh sizes for precision cleaning.

GET THE FACTS on Hydro-Finish! Write today for Bulletin 1400-A to: PANGBORN CORPORATION, 3500 Pangborn Blvd., Hagerstown, Md.

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control Equipment.

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BLAST CLEANS CHEAPER
with the right equipment for every job

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MEANS "ACCURATE MARKING"

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Hand and Motor Driven Models

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AMERICA'S LARGEST MFGR. OF ADVANCED BARREL FINISHING EQUIPMENT, MATERIALS & COMPOUNDS

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- Attractive, durable finish that resists abrasion, most alkalis, acids and organic solvents.
- BLACK MAGIC Zinc Black makes an excellent bond for subsequent applications of paints and lacquers.
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Also: BLACK MAGIC for Steel, Iron, Cadmium. Rustproofing oils, waxes, metal cleaners, heat treating salts. Send for catalog.

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WITCH-DIP & WITCH-OIL FINAL FINISHES

SILCO Glass-Base PROTECTIVE COATING
HEAT TREATING SALTS. CLEANERS. ETC.

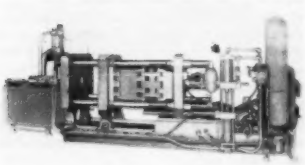
For additional information circle No. 47 on the Reader Service Card

NEW PRODUCTS

For additional information on the products appearing on this and the following pages, mark the key number of the item on the card bound into this issue. Drop the card in the mail — no postage is required.

DIE CASTING MACHINE HYDRAULIC SYSTEM IS DESIGNED FOR SAFETY

Cast-Master
Miller-Taylor Tool Co.



SPECIAL FEATURES: A new hydraulic system is utilized by Miller-Taylor in the "Cast-Master" die casting machine. Designed to eliminate the fire hazard at the hot metal end of the machine, the system is a water-actuated, closed shot operation which provides required safey without use of costly fluids or expensive corrosion-proof components.

SPECIFICATIONS: Heart of system is master oil cylinder directly connected to a master water cylinder which actuates a remotely located slave shot cylinder. The closed system is designed to use a master water cylinder having same bore as the slave shot cylinder, while master oil cylinder has larger bore. Manufacturer claims this intensifier relationship between master and slave cylinders will result in less leakage and longer pump life since the vane pumps used to charge the accumulator can operate at a lower pressure. Water jacketing the shot cylinder cools water soluble pressure fluid and improves the life of piston rod packing which heretofore had required excessive maintenance because of operating above the hot metal pot.

For additional information circle No. 43 on the Reader Service Card

TOOL HOLDER FOR LATHE WORK

Dimco
Kelvin Systems Corporation

SPECIAL FEATURES: The "Dimco" is a rugged new universal tool holder for quick and accurate clamping on the lathe. Made in two sizes, the unit has been designed to fit any engine lathe for production runs. It permits the operator an unusual amount of flexibility and ease along with complete accuracy in interchanging multiple tool setups.

SPECIFICATIONS: Main center section fixed in position on the compound which may be rotated through 360 degrees for a setup for any series of operations. Once the center section of the tool post is placed for the operation there are three possible positions for any of the tool setups, since there are slides on two sides of the main section and a set of slides in front. The "Dimco" is provided with a quick change cam action to permit interchanging of tool setups in a minimum of time between operations.

For additional information circle No. 118 on the Reader Service Card

BARREL FINISHING ADDITIVE FOR FINE FINISH

Blue Magic Compound No. 1
Blue Magic Chemical Specialties Co.

SPECIAL FEATURES: Principle advantages claimed are economy, fine finish, uniform metallic colors, and greatly reduced time cycles for barrel finishing brass, bronze, copper, gold and silver castings. Can be used for finishing with or without media, and with selected non-ferrous media for roughing, deburring, cleaning and finishing in a single operation.

SPECIFICATIONS: A highly concentrated paste. Recommended quantities are only 4 ounces of compound for finishing runs in a 32" x 30" tumbling barrel at high water level. As a cutting compound in deburring operations 1 to 2 ounces of compound at low water level in the barrel are needed.

For additional information circle No. 119 on the Reader Service Card

INSIDE GRINDING, POLISHING AND DEBURRING

Belt Strapper
Behr-Manning Corporation

SPECIAL FEATURES: Simplifies inside diameter grinding, polishing and deburring by adapting the Behr-Manning backstand method of coated abrasive belt finishing to this Belt Strapping Unit. Reduces the time normally required in ID finishing of such items as cast parts where interior flash removal is a problem.

SPECIFICATIONS: Set up with a polishing jack on motor drive and spring-tension small backstand idler. No shut-down time is involved in threading the coated abrasive belt through the opening of the piece being finished, as the operator merely releases the belt tension with a foot treadle which allows for belt stoppage at the drive unit.

For additional information circle No. 15 on the Reader Service Card

POWER TOOL

Delta No. 19-150 Air Hydraulic Drill Unit
Delta Power Tool Division, Rockwell Manufacturing Company

SPECIAL FEATURES: Simple design tool developed for rugged, high production work on drilling, reaming, tapping, chamfering, etc. The unit can be quickly adjusted to suit the requirements needed for each operation because of its infinite feeds, which eliminate the need for cams.

SPECIFICATIONS: Thrust is obtained from energy received from the plant compressed air supply. Its feed control is a sealed pump-

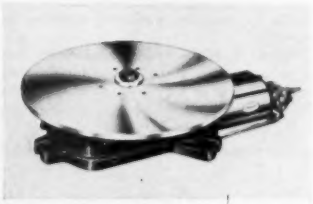
less hydraulic system. Depth controls are adjustable positive stops. The normal cycle gives rapid advance to the work, drilling feed and rapid return.

Feed control is infinitely variable from 0 to 70 inches per minute, by means of a metering valve. The rapid advance is 6 inches per second and is variable in length up to the full stroke of the unit. The total stroke may be varied from 0 to 1½ inches by means of a positive stop. The return rate is 5 inches per second.

For further information circle No. 120 on the Reader Service Card

HEAVY DUTY DIAL-FEED TABLE

Model Bret-22
The Bellows Co.



SPECIAL FEATURES: Can be set to position 4, 6, 9, 12, 18 or 36 stations. The 22" diameter table quickly and accurately positions loads up to 1000 pounds. Cushioned air power eases the table into position where it is locked by an air cylinder.

SPECIFICATIONS: Table is powered by a special 3⅝" bore Bellows Air Motor, complete with built-in Electroaire directional valve and speed controls. The valve is controlled by the Bellows 12 volt solenoid control units which are guaranteed against burnout. Table top is easily removed for mounting jigs and fixtures, or oversize table.

For further information circle No. 16 on the Reader Service Card

SHOCK PREVENTION IN HIGH PRESSURE HYDRAULIC SYSTEMS

Surge Damping Valve
The Denison Engineering Company

SPECIAL FEATURES: Small and compact, can be installed as easily as any ordinary fitting and does not interfere with other functions of the circuit. Principle of operation approaches uniform acceleration which assures smooth, shockless action in circuit regardless of pressure used. Adjusts itself automatically to any working pressure, requires fraction of second to act and cannot slow down cycle time. Prevents damaging vibrations caused by sudden starting, or reversing flow. When flow is interrupted, valve quickly resets and is ready for next operation. Requires no manual adjustments and has no external drain.

SPECIFICATIONS: Spool inside is normally held closed by spring to prevent flow from inlet to outlet. Moves to fully open position at rate controlled by small, built-in valve that is responsive to difference between outlet and inlet pressures producing different opening

To meet MILITARY SPECIFICATIONS

for Cleaning • Rust-Removing • Etching Phosphatizing and General Metal Conditioning of all kinds of Metal Surfaces

Use PREP PRODUCTS!

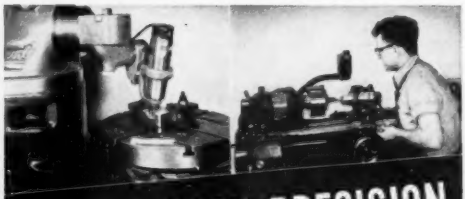
SPECIFICATION NUMBER	CONFORMING MATERIAL
MIL-C-5541 (see also QPL-5541-1)	Lyfanite
MIL-S-5002	Lyfanite
MIL-C-10578	
Type 1	Metalprep Nos. 77, 102—Alumiprep No. 1
Type 2	Metalprep Nos. 10, 15—Alumiprep No. 20
JAN-C-490—Grade II	
Type 2	Emulsoprep
Type 4	Metalprep, Prep-Rik-L, Alumiprep, Prep-Rite
Type 5	Metalprep, Alumiprep, Prep Rik-L, Prepwash
Type 6	Emulsoprep No. 710-E.C.
U.S.A. 3-213	(See MIL-C-10578)
U.S.A. 3-192	Metalprep Nos. 28, 10, 15 Alumiprep No. 20
U.S.A. 98-20007	Metalprep Nos. 10, 15 Alumiprep No. 20 Prep-Rite No. 16
U.S.A. 72-53	(See AN-F-20)
AN-F-20	Lyfanite
	Metalprep Nos. 10, 15, 77, 102 — See MIL-C-10578
	Alumiprep Nos. 1 and 20 — See MIL-C-10578
AN-E-19	Lyfanite
AN-C-170	(See MIL-C-5541)
TAC-ES-431	(See MIL-C-10578)
AXS-1245	(See JAN-C-490, Grade II)
Engineering Corps—T-1184	Metalprep No. 28
U.S.N.—Appendix 6 51-C	Metalprep

Send for Data Sheet • Advise Govt. Spec. Number

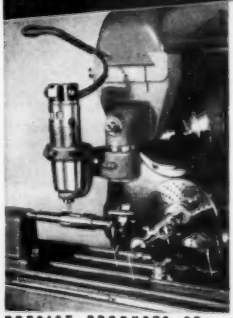
NEILSON CHEMICAL CO.

3462 Tecumseh Rd., Windsor, Ont. — 6343 BENSON ST., DETROIT 7, MICH. — 3471 Union Pacific Ave. Los Angeles 23, Calif.

For additional information circle No. 51 on the Reader Service Card



LOWEST COST PRECISION FOR TOOL ROOM AND PRODUCTION



ONE PORTABLE MULTI-PURPOSE PRECISE GRINDER-MILLER WITH MACHINE TOOL MOUNT DOES THE WORK OF A SINGLE-PURPOSE MACHINE COSTING 100 TIMES AS MUCH!

Little can be done today to reduce labor and material costs. For substantial savings employ new, better techniques. Mount PRECISE Grinder-Millers on lathes, drill presses, milling machines and other machine tools or use in special production set-ups. ¼ HP. speeds from 20,000 to 45,000 r.p.m.; 115 volts, AC-DC. Ruggedly built for continuous duty. All metal housing; rigid PRECISE quill; sealed micro-precision bearings. *High speeds and accurate PRECISE quill and chuck are ideal for tungsten carbide cutters.* PRECISE will grind, mill or finish any material from soft wood to the hardest alloy steel.

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PRECISE PRODUCTS CO., 1342 Clark St., Racine, Wis.

PRECISE GRINDER-MILLERS

For additional information circle No. 59 on the Reader Service Card

speeds at various pressures. Valve will open at slower rate of speed at high pressures than at low pressures when it is subjected to sudden surges of fluid. Rate of flow will increase as pressure in outlet line of valve approaches that at inlet side.

For additional information circle No. 121 on the Reader Service Card

---

METAL FINISHING TOOLS
All-Purpose Carbide Cutter Sets
M. A. Ford Manufacturing Co., Inc.

SPECIAL FEATURES: Each set designed to meet a broad range of applications as they offer from 5 to 12 shapes suitable for various types of burring, light milling, blending and finishing. Use of proper tool for specific applications results in savings in production time as well as less wear and damage to the tools themselves.

SPECIFICATIONS: Made from precision ground carbides. Tool sizes in the various sets include 1/4" bodies on 1/4" shanks, 1/8" bodies on 1/8" shanks, and 1/4" bodies on 1/8" shanks.

For further information circle No. 122 on the Reader Service Card

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You Can Make Savings Like These

in Small Hole Drilling with the Dumore Automatic Drill Head

Priced at only $185.00

DDH-10A

Stigor Co. cuts drilling costs	F. C. Russell Co. lowers drill replacement costs	Omco Corp. increases production
97%	**80%**	**100%**
Cost per piece	Drill replacement	Pieces per hour
BEFORE $.385 per piece	BEFORE $425 per yr.	BEFORE 90 per hr.
WITH DUMORE $.0117 per piece	WITH DUMORE $85 per yr.	WITH DUMORE 180 per hr.

Write for bulletin with user job reports

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For additional information circle No. 22 on the Reader Service Card

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These famous long-wearing buffs run cool under all buffing conditions. Constructed of high count bias-cut cloth mounted on safe steel centers. Available in a wide range of densities and center diameters.

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STYLE C-20 CONTACT WHEELS and F-26 Belt Lubricant
A C-20 flexible Contact Wheel will form itself to the shape of the work and permit the abrasive belt to polish contoured surfaces and F-26 Abrasive Belt Lubricant will increase belt life by preventing loading and glazing. Produces finer, smoother and brighter surfaces through lubrication.

for
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A complete line of production buffing compounds. Produced in bar and tube form. Formax is the originator of the "Spraymax" Liquid Compounds for brush or spray application.

for
FLEX-A-GLU POLISHING WHEEL CEMENT—A flexible synthetic adhesive in a ready-to-use form. Dries quickly. Increases polishing wheel life and produces uniform finishes regardless of grit size used.

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FORMAX MANUFACTURING CORP
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MANUFACTURED IN CANADA BY JOHN GALLOWAY LTD., KITCHENER, ONT.

For additional information circle No. 25 on the Reader Service Card

Ne[illegible]eations

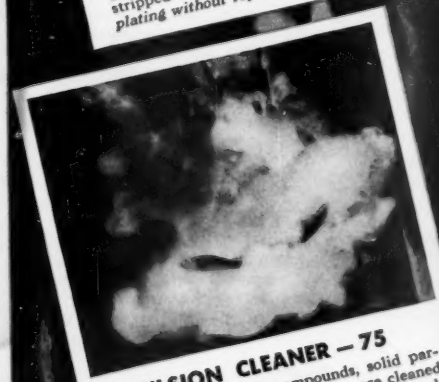
[illegible]AL FINISHING . . .

METAL STRIPPER — A

An outstanding development for stripping defective electroplated nickel, copper, silver, cadmium and zinc from steel. Fast action . . . no basis metal attack. The highly polished grill cover illustrated has been completely stripped of nickelplate, and is *ready for replating without repolishing.*

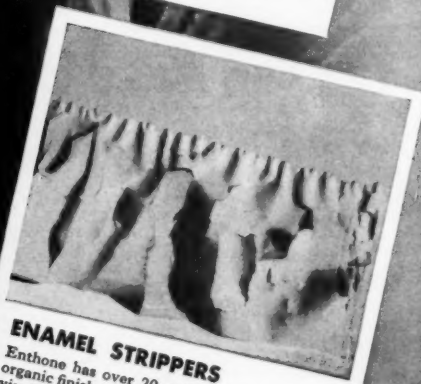
EBONOL BLACKENING PROCESSES

Ebonol finishes are used to beautify a widely diversified list of superior quality products. Photo shows steel parts blackened with Ebonol-S and S-30; copper and brass with Ebonol-C; zinc with Ebonol-Z. U. S. Patents — 2,364,993, 2,460,896, 2,460,898.



EMULSION CLEANER — 75

Oils, greases, buffing compounds, solid particles, deep seated in steel parts are cleaned out and completely removed by this emulsification process. Stubborn, gummy substances on die castings, milling machines, floors, motor blocks emulsify and disperse in water instantly.



ENAMEL STRIPPERS

Enthone has over 20 strippers for removing organic finishes — synthetic enamels, lacquers, vinyls, japans. The best strippers, tailor-made for your particular problem, are selected by laboratory technicians after test runs. This service is rendered free of charge.

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Enthone Incorporated

[illegible] ELM STREET [illegible] HAVEN, CONN.

PISTOL-GRIP BORE GAGE

Nilco Pistol-Type Bore Gage
Nillson Gage Co., Inc.

SPECIAL FEATURES: Designed to check bores on the machine by the operator where space is limited and it is impractical to use a standard length bore gage. Indicators are positioned to proper angle so that gage will face the operator at all times.

SPECIFICATIONS: Simple construction, including three-point alignment, two-point gaging, one piece construction centralizing plungers and interchangeability of parts. Any size, type or make indicator can be adapted to the gage.

For additional information circle No. 123 on the Reader Service Card.

TUMBLING MACHINE WITH INCREASED CAPACITY

Grav-i-Flow Machine
Grav-i-Flow Corporation

SPECIAL FEATURES: With two 18" x 40" ID compartments the machine offers increased capacity per area of floor space over previous equipment, permitting the grinding, deburring and finishing of metal parts in larger quantities in faster time cycles.

SPECIFICATIONS: 220-440 volt, 5 H. P. motor has a magnetic brake. Water and electrical services are integral with the machine and available for instant convenient connections. Compartments are furnished with ½" plate unlined or ¼" plate rubber-lined; doors have cam locks with manually released safety stops to provide pressure relief. Magnetic starter has a reduced voltage control to meet plant electrical standards.

For additional information circle No. 124 on the Reader Service Card.

TANTALUM HEATING COILS AND HEAT EXCHANGERS

Unichrome Tantalum Heating Coils and Unichrome Tantalum Heat Exchangers
United Chromium, Incorporated

SPECIAL FEATURES: Heating coils and heat exchangers utilizing tantalum tubing. Tantalum possesses heat conductivity better than steel and superior to any lead alloy. Its great strength permits the use of tubing with thin walls, with no allowance necessary for loss of strength due to corrosion. Good conductivity plus thin walls provide fast heat transfer with minimum lag and therefore much closer regulation of bath temperatures.

SPECIFICATIONS: Extremely durable. Tantalum is virtually acid-proof, resistant to all the acids commonly found in the plating room, except straight hydrofluoric acid. Recommended for chromium plating solutions that are severe on the lead coil or special alloy heat exchangers generally used. Free from corrosion and scaling that form heat-insulating coatings and present a maintenance problem. Should not be used in alkaline baths where ordinary iron or steel serves the purpose.

For additional information circle No. 125 on the Reader Service Card.

This FREE New Booklet Tells You How

In its 28 illustrated pages you'll find the answers to many questions that affect the success of your electroplating on steel. You'll want to read more about:

- ¶ Which costs more: good electrocleaning or poor electrocleaning? *See page 4.*
- ¶ How can cleaning costs be reduced 33⅓% while plating quality is being improved? *See pages 7 and 8.*
- ¶ What are four easy ways to improve the average rinse tank? *See page 10.*
- ¶ What rinsing fault is "an invitation to trouble" in the plating of high-carbon steel? *See page 11.*
- ¶ Why is it better to clean steel with reverse current than with direct current? *See pages 12 to 14.*
- ¶ What causes hydrogen embrittlement during electrocleaning? What is the remedy? *See pages 15 and 16.*

FREE For a copy of *"Four good steps toward better electroplating on steel"*, write to Oakite Products, Inc., 34G Thames St., New York 6, N. Y.

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PMM USEFUL LITERATURE

For additional information on the products appearing on this and the following pages, mark the key number of the item on the card bound into this issue. Drop the card in the mail—no postage is required.

PROCESSES

Comprehensive Report on Investment Casting: No. 144

A thorough survey of the investment casting process, including production techniques, selection of alloys, effect of variables upon accuracy, review of the advantages of the process, and some design tips are contained in "A Critical Review of Investment Casting", a reprint offered by Arwood Precision Casting Corp.

Specialists in Small Die Castings: No. 29

Unique production facilities for their "smallness unlimited" zinc die castings are described in a new booklet available from Gries Reproducer Corp. Charts, diagrams and photographs provide considerable information on design, physical properties and process.

Stainless Steel Parts by Powder Metallurgy: No. 145

Production of three classes of parts from stainless steel powder is announced in literature from Amplex Manufacturing Co., Div. of the Chrysler Corp. Oilite stainless steel bearings, filters and machine parts are being successfully produced where corrosion resistance is needed under severe operating conditions. Self-lubricating Oilite bearings of stainless steel, filters with accurately controlled porosity, and structural parts with favorable physical properties, are reported.

Powder Metallurgy—Present Status: No. 146

"Powder Metallurgy Today" is an attractively prepared and bound booklet prepared for distribution by the F. J. Stokes Machine Company. Range of subject matter covered by this readable publication includes a description of the process, a report on general and special applications, and mechanical characteristics and design of powder metal parts.

Keeping Investment Casting Costs Down: No. 147

Of the many factors affecting the cost of parts produced by investment casting one of the most important is the specification of tolerances on non-critical dimensions, according to an article appearing in the Haynes Alloys Digest. The article is complete with charts showing the dimensional variation of investment castings.

Improved Technique For Casting Rotors: No. 148

Use of induction melting in improved technique for rotor casting is described in an 8-page illustrated article offered by the Ajax Engineering Corporation.

Sound Castings From Nickel Silver: No. 149

A detailed description of proper foundry procedure for production of sound castings from nickel silver together with specification information is available from R. Lavin & Sons, Inc.

Handbook of Copper Base Casting Alloys: No. 150

Important specifications for copper base castings are listed in a handbook offered by the Barth Smelting Corporation. It contains, in detail, Federal, Navy, ASTM, SAE and AMS specifications. A data section offers constitutional diagrams and other valuable reference material.

Casting In Non-Ferrous Alloys: No. 151

Engineering information helpful in the design of non-ferrous castings is contained in a 16-page booklet issued by The Wellman Bronze and Aluminum Company. In addition to complete charts on composition and properties of aluminum, magnesium, copper and Ampco metal alloys, the book has reference data on relative weights of structural metals, properties of cast metal, shrinkages on patterns and a description of Wellman casting facilities.

MATERIALS AND EQUIPMENT

Mold Temperature Control: No. 152

Exclusive features and specifications of the Sterlco Mold Temperature Control Unit, a self-contained device for heating or cooling water to maintain a constant temperature while circulating through passages in a mold or die, are described in a bulletin offered by Sterling, Inc.

Die and Mold Finishing Specialties: No. 153

A complete line of die and mold finishing specialties put out by Metal Removal Company is described and illustrated in a new catalog just off the press.

Quarterly Publication Has Die Casting Machine Data: No. 154

Pertinent information relating to die casting machines and plastic molding presses is contained in The Lester Press, a quarterly publication from Lester-Phoenix, Inc. The current issue gives information concerning lists of parts for die casting machines that should be kept in stock for replacement and repair purposes.

Die Lubricants for Die Casting & Permanent Mold Casting: No. 155

A special die casting lubricant, especially useful for aluminum, is covered in a product data sheet from E. F. Houghton & Co. which describes Mouldlubric 306. Also covered on the sheet is Houghton's die casting lubricant No. 5 which is not only useful for die casting die lubrication, but also for mold lubrication in permanent mold casting.

Plating and Anodizing Rectifiers: No. 156

Selenium rectifiers for plating and anodizing are the newest additions to a line of metal finishing processes, materials and equipment sold by United Chromium, Inc. These rectifiers are made with highest grade, American made selenium plates. Complete information is available from United Chromium.

Turbo-Compressors Useful for Sintering Atmospheres: No. 157

Turbo-compressors and a wide range of applications for which they are used are described in literature from the Spencer Turbine Company. The bulletin is complete with charts, drawings and photographs of installations.

Midget Die Caster: No. 158

The new Kux Model K, a small die casting machine, is described in an illustrated folder offered by the Kux Machine Co. The Model K is available in horizontal or vertical center

continued on page 58

shot models and capable of producing die castings weighing up to 1½ pounds in zinc under high injection pressures.

Prepared Atmospheres for Use in Powder Metallurgy: No. 164

The preparation of the proper gas atmospheres for such specific heat treating operations as sintering in powder metallurgy, case carburizing and dry cyaniding is covered in a two-color booklet available from Surface Combustion Corporation. Included is a comprehensive chart giving types of gases, their compositions by volume, applications and approximate cost per thousand cubic feet.

Machining Hard Metals by Means of Controlled Spark Discharge: No. 165

The Method X Machine which machines sintered carbides, super alloys and other "hard-to-machine" metals by means of a controlled spark discharge is described in a bulletin available from the Method X Company.

FINISHING

Power Screwdrivers for Use with Self-Tapping Screws: No. 57

"Power Screwdrivers for use with Parker-Kalon Self-Tapping Screws for Faster Assembly" is the title of a new booklet released by Parker-Kalon Corp. The bulletin gives specifications for and illustrates many types of power screwdrivers for production line use.

Single Operation Metal Cleaner: No. 159

Removing oil, rust and dirst while also conditioning the surface for superior paint adhesion are accomplished in one operation by Oakite Compound No. 33, according to a new booklet issued by Oakite Products, Inc.

Practical Hints on Barrel Finishing: No. 160

The third of a series of articles on barrel finishing appears in the current issue of "Grits and Grinds," a monthly house organ published by the Norton Company. This month's article is designed to assist the tumbling room operator to get satisfactory results in the shortest time, prevention of work stoppages and reduction of operating costs.

Vapor Degreasing Equipment: No. 161

Degreasing equipment produced by Phillips Manufacturing Co. is described in an illustrated bulletin put out by the company. The bulletin gives a detailed account of how the degreasers operate and some of the specific applications.

Fast Electric Impact Hammer: No. 162

Specifications and uses for the Electropunch, a new, fast, electric impact hammer produced by Black & Webster, Inc., are given in a bulletin put out by that company.

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Expensive gaskets for this 9⅝" long, intricate cast aluminum body have been eliminated with a 48" Lapmaster by lapping the joint surface flat to an all-over light band pattern. Pressures up to 3500 psi can be sealed when mating faces (of sturdy pump parts) are lapped to this tolerance.

The Lapmaster 48" readily handles large and small parts of a wide variety of shapes and materials in production runs. *This machine does not require conditioning of the lap plate, it uniformly distributes "wet" lapping compound, and it operates with practically no maintenance.*

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Production on the valve body part shown above is maintained at the rate of 8 parts per five minute cycle. The machine is equipped with 4 lap-conditioning rings each holding two parts.

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continued from page 27

mechanical elements of the system are designed to give full protection to the operating mechanism. These parts are not subject to red rust and, protected with a coating of baked enamel, are highly resistant to corrosion of any sort.

A wall thickness somewhat heavier than would be possible for such a deep shape if drawn from the sheet metal, is simple to die cast. In addition, several hollow-cored mounting bosses are formed integrally, as is the aperture through which the metering mechanism operates.

The base plate is also die cast with cored mounting holes around its perimeter to mate with cored screw holes in the housing. A generous area of mounting surface between base plate and housing is provided so that there will be adequate stock around screw holes, but by the use of metal-saving cores, an excessive section thickness is avoided.

For the motor mount within the housing, another die casting has been used. Four bosses rising from a flat, triangular plate, provide mounting for the motor plate and gear train. While two holes for mounting the motor are cored close enough to center distances, no attempt is made to core the gear mounting bosses hollow. Center distances need to be held more closely and are therefore, drilled and tapped.

Rigidity and freedom from warpage are important in this critical little die cast motor mount, substantial, radial ribs connect the mounting bosses with the large center boss, so that no difficulty is encountered either during ejection or service.

To be able to put this unit on the market at a reasonable cost, it has been necessary to minimize secondary operations which generally represent a larger part of the finished piece cost than the price of the raw casting. By employing die cast parts, the machining has been confined to a few simple drilling and tapping operations.

3M Belts cut costs Because They Last Longer

King Foundry, Minneapolis, reports 3M Abrasive Belts last 6 times longer than ordinary belts, resist loading on aluminum and brass castings.

No more production slow-downs for frequent belt-changing at King Foundry, Minneapolis! A 3M Methods Engineer recommended the *right* 3M Abrasive Belts for their job. Now operators report less loading—faster, smoother cutting, and belts are lasting 12 hours instead of 2 hours with previous abrasives. Production's up to 300 cast-aluminum housings per belt!

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Design of this unit is stable and it will not be necessary to make annual changes, as is characteristic of the household appliance field in general. Thus, die costs, while high, can be amortized over a longer period for the Chlorinet.

The fact that the construction of this unit is simple and rugged reduces the amount of servicing and maintenance necessary . . . once installed and adjusted, there is little likelihood that either the die cast housing or the mechanism of this hypochlorinator will require servicing or repair.

OPPORTUNITIES

Midwest casting sales and engineering representation firm with representatives located in all principal midwestern cities desires a connection with an investment casting concern. Please reply to Box 11251 Precision Metal Molding.

FOR SALE—Lester Phoenix cold chamber die casting machine, 28 x 34 platen area. Write Precision Metal Molding Magazine, Box 11151.

FOR SALE—Late model, automatic, high speed Hi Pressure Zinc Die Caster.

Practically new, custom built to rigid specifications. 15 H.P., hydraulic pump unit, air injection.

Capacity 1,200 cycles per hour. Can be seen running on an intricate job at 500 shots per hour. Unique built-in longitudinal core pulling mechanism.

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SERVEL CHAIRMAN TO ADDRESS METAL TRADES

Louis Ruthenburg, chairman of the board of Servel, Inc., of Evansville, Ind., will give the opening address at the 52nd annual convention of the National Metal Trades Association to be held at Chicago's Blackstone Hotel on November 14, 15 and 16. Mr. Ruthenburg will speak on "Management's Responsibilities".

SAVINGS UP TO 84%

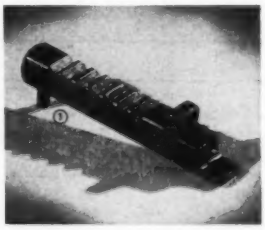
continued from page 38

ricator completed, including the lateral holes which have to be drilled after manufacture of the powder part is complete. The several offsets and the holes in the base are all molded.

This selector drum was originally designed for manufacture from metal powders and represents an excellent example of cooperation between design engineer and powder metal fabricator. It is possible to make this piece by conventional machining methods, but the number of operations and the cost would be fantastic.

Working with the selector drum, just described, is the selector plunger, Figure 7. This plunger is a steel piece originally made from two machined parts brazed together. This plunger fits into one of the slots in the drum and is part of the selector mechanism.

OVER 90 PERCENT THEORETICAL DENSITY and with some dimensions as close as ± .001, this selector drum is an outstanding job of powder metallurgy.



IN PLACE OF TWO MACHINED PARTS brazed together, this selector plunger is investment cast in SAE 1117.

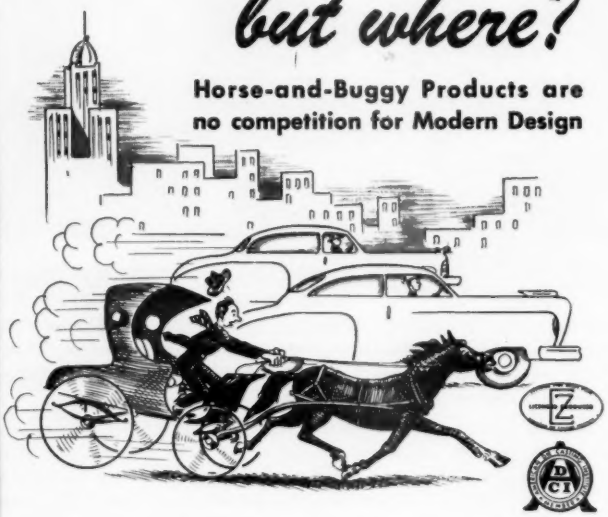
Redesign has allowed the manufacture of the plunger by the investment casting method. Since this plunger mates with the selector drum, tolerances are equally strict. All dimensional requirements have been met by the supplier, the Perrier Company, who cast the part of SAE 1117 and harden to 79 Rockwell "A" minimum.

The change from machining and brazing to investment casting on this part has brought a cost reduction of 21 percent.

HE'LL FINISH . . .

but where?

Horse-and-Buggy Products are no competition for Modern Design



Many a worthy product of yesteryear finds itself lost in today's streamlined distribution race. The reason can often be traced to the manufacturer's failure to keep apace of competition in the use of modern design and production methods.

Be sure your product enjoys the advantages of Badger die castings to keep it ahead of the field.

Our enlarged engineering and production facilities can help you realize greater economy, greater efficiency, and greater sales appeal.

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PMM INDUSTRY NEWS

APEX SMELTING ANNOUNCES CHANGES

William A. Singer, president and chairman of the board of Apex Smelting Co., Chicago, Ill., has announced the following promotions and reassignment of its officers.

Louis Lippa, vice-president, will assume the office of treasurer, formerly held by George Starmann, Sr., retired; also the duties of vice-chairman of the board.

Robert K. Beck will continue as vice-president and will assume the office of general manager of all operations.

Fritz Nussbaum, vice-president, assumes the duties of manager of raw material purchases for all plants.

A. J. Peterson has been promoted to the office of vice-president in charge of sales and advertising with headquarters in Chicago.

D. L. Palmer has been promoted to assistant vice-president and Cleveland works manager.

William R. Bayer continues as secretary-assistant treasurer and controller.

William N. Brammer, assistant sales manager, Cleveland district.

David A. Schiffer, assistant manager of raw material purchases, Cleveland Works.

Directors remain unchanged and are: Robert K. Beck, Louis Lippa, Fritz Nussbaum, Gordon W. Reed, William A. Singer, George H. Starmann, Sr.

COMPANY MOVES

Metals Removal Company of Chicago has moved its general offices and research laboratories into a modern new building at 1546 North Orleans Street.

RUSSEL WRIGHT ELECTED TO HEAD DESIGNERS

Russel Wright, New York industrial designer, was elected president of the Society of Industrial Designers for the year 1951-52 at the annual meeting of the organization October 5. Mr. Wright succeeds Dave Chapman, Chicago designer, who has been president for the past year.

Other officers elected were Carl Bjorncrantz of Chicago, vice president; Jean O. Reinecke of Chicago, secretary; and A. Baker Barnhart of New York, treasurer.

Russel Wright, one of the founders of the Society of Industrial Designers,

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This greater design flexibility resulted in a new product achieving far-reaching sales advantages . . . because Scripto decided to "ask GRC." "Gries" exclusive facilities produce simple or intricate tiny parts in one automatic operation . . . completely trimmed, ready for use . . . . 100,000 parts or many millions.

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Faster Production
Close Tolerances
Reduced Scrap Loss
Simplification
Product Improvement
Economy
Design Flexibility

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has long been known for his work in all phases of home furnishings design.

The Society's national meeting is being attended by the nation's top men in the industrial design field, with representation from New York, Detroit, Cleveland, Pittsburgh, Chicago, and other sections of the country. This is the first time the group has held a national conference outside the New York area.

HEAD METALS RESEARCH

Dr. Max Hansen has been named chairman and Robert A. Lubker, associate chairman, of the Metals Research Department of Armour Research Foundation of Illinois Institute of Technology. Dr. Hansen succeeds Dr. Carl Swartz who becomes metallurgical consultant.

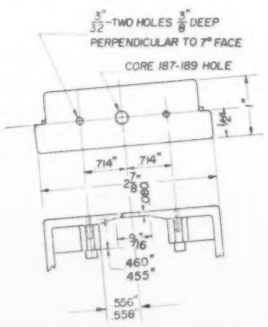
FLEXURE UNDER LOAD
continued from page 33

pin holes in the sides (with diameters of .087 + .000.003) but also four mounting holes in the base, two holes for self-tapping screws to mount the dial, one in the top to provide an anchor for the spring, and a hole for the pinion shaft.

Small design changes yield big savings

The phrase "close cooperation" between customer and supplier is one

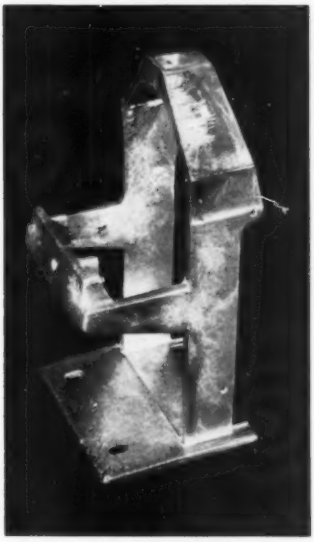
CLOSEST AS-CAST dimension is the .556-.558 between the pinion shaft hole and the boss against which the rack rides.



that is sometimes loosely applied, but in this instance, there are several concrete examples of the way in which this interchange and consultation between Pelouze and its casting supplier saved money. Minor changes have, in fact, brought a 14 percent reduction in piece prices, since production was originally started.

A small rib originally specified in the center of the base caused considerable casting trouble. This small rib was to serve as a lower stop for the downward motion of the platform assembly.

Undue shrinkage around this rib resulted in excessive rejects from cracking, warping and improper surface conditions. The caster brought this condition to the attention of Pelouze engineers.



SAVING OF 32 TONS of steel on 10,000 units has been brought about by the change from stampings to permanent mold aluminum frame.

It was found that the rib could be eliminated by a small, stamped lug to the bottom of the platform assembly, thus serving the same purpose as the cast rib at lower cost.

A thin section near the top of the side walls of the casting was originally specified to be machined. Straddle milling was an expensive and difficult operation. When this problem was presented to the caster, he decided that he could cast this thinner section, thus eliminating a machining operation.

One critical problem has been the reduction of friction, and one specific place where this has been a problem is the hole for the pinion shaft. In order to reduce friction at this point, it was decided to have the front section which supports the pinion shaft as thin as possible.

It was originally thought necessary to machine this, since it involves a wall section .060 thick which would be difficult to fill in casting. However, the supplier undertook to produce this feature, thus saving an extra machine operation.

Aluminum alloy of widely varying analysis can be cast successfully by this process permitting utilization of lower grade scrap. Thus, the change from steel stampings to cast aluminum has meant that, for each 20,000 scales, 32 tons of steel needed for de-

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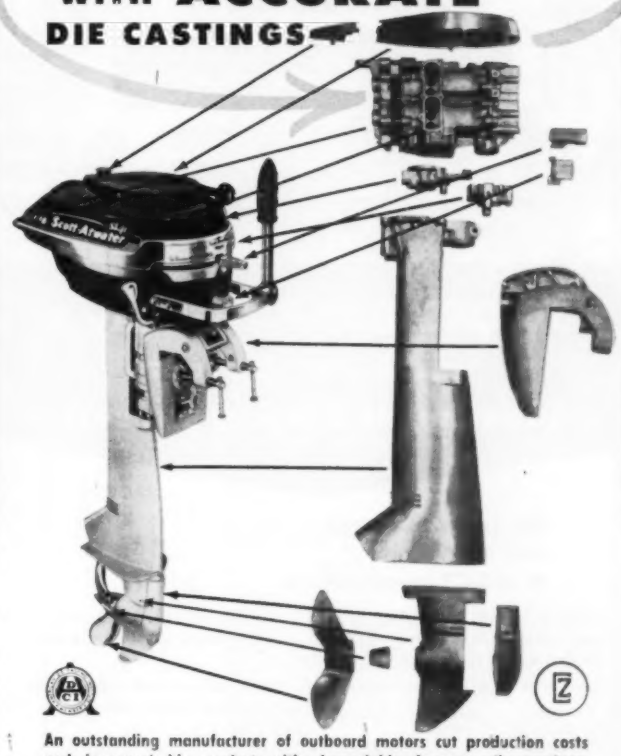

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NE·NE·NE·

the hub on the bronze disc. Since the smooth operation of a device of this nature depends on good contact at all times between the three plates, the specification for flatness, parallelism and perpendicular relationship to the bore are important.

In order to meet these requirements, the Wel-Met Co. coins the pieces after sintering. This operation, while increasing the cost to a slight extent, assures meeting the requirements called out by the drawings.

DOW CONSIDERS EXPANSION

The Dow Chemical Company is considering increasing its new plant facilities at the rate of $100 million a year for the next several years, Leland I. Doan, Dow president, announced to a meeting of the company's stockholders.

Doan said the projected expansion was necessitated by a combination of civilian and defense requirements.

CONTROLLED POROSITY
continued from page 31

to the leading edge of the aerofoil. Here it is swept back over the upper and lower surfaces by the air flow. The purpose of the dam is to confine the flow of liquid lengthwise along the secondary channel.

Close control over the flow along the length of the distributor is obtained by varying the bore or length of the flow control tube, each tube being individually calibrated to give the correct flow of de-icing liquid under working conditions.

The control of distribution is necessary to overcome the pressure difference between the top and bottom of the fin of anything up to 6 or 7-lbs/sq.in. caused by the head of the fluid itself. This is allowed for and the distributor designed to deliver the correct quantity of fluid along the fin by fitting the flow control tubes with the correct flow characteristics.

The distributors are designed to allow for other factors such as a change in aerofoil section, pressure drop due to the head caused by the dihedral angle, the deflection of the wings during flight and the pressure drop down the primary feed channel itself, in fact all contingencies that may arise due to changes in pressure or flow requirements may be met.

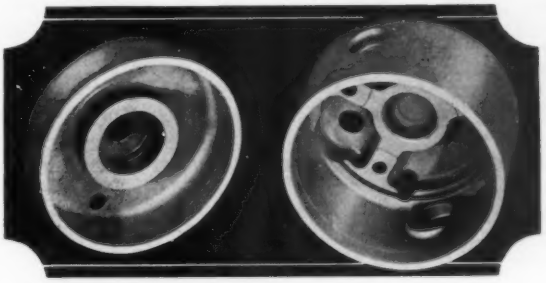
The porous material

The main requirements for the porous metal are that it must give constant results and have reasonable mechanical strength. Porous metal is made to fulfill these requirements by careful control over the structure and pore size.

Early attempts to make porous metal with the required liquid flow characteristics produced a substance with very small pores which choked too readily: later a technique was developed which produced a porous metal with the correct degree of porosity.

The porous metal is made from copper, nickel and tin powders care-

"Cleveland"
DRIVE & BRUSH END-COVERS



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fully controlled in both mesh size and particle shape. After experimental work with fine powders, passing through 300 mesh, the following fractions were selected and mixed in a tumbler.

Nickel powder, made by the carbonyl-process, mesh size through 200 mesh but on 350 mesh, tin powder through 100 but on 200 mesh.

The mixing of this powder was difficult due to the variation in particle mobility both during and after mixing. The powder was stabilized by using a fatty acid, in powder form, which could be volatilized during the sintering operation.

Production Technique

The manufacture of the distributor entails some 35 operations including the testing during processing. This does not include the making of the tubing which is obtained from outside supplier.

The special square section Monel metal tube is first cut to length and all holes drilled to correct dimensions. Allowance has to be made for length changes caused by later sintering and brazing operations, but as these follow a set pattern it is not difficult.

The ends of the tube are filed to gauge length and plates welded on to seal both the primary feed channel, Figure 1. (A) and the upper lips. The fixing screw bushes are pressed into the drilled holes and copper rings placed over the ends and the assembly passed through a brazing furnace.

The flow control tube 1/16" in diameter by .016 bore is cut to length bent and tested.

The flow control tubes are assembled with cover tube "F" and pressed by hand into the holes drilled in the central web "B". A small copper wire ring is placed around each tube at the surface nearest the drilled hole. Dams "G" are then fitted in and a suitable copper paste painted on the interface. The assembled tube is next passed through a conveyor furnace and brazed.

A water test to check both the brazing and the distribution is made for the next operation of sintering. The

metal powder mixture is filled by hand, into the open face of the square tube and is prevented from entering the open end of the control tube by the cover tube. A mild steel strip, suitably covered is placed over the surface of the metal powder sealing the open face of the tube. The assembled tube is placed face downwards on the belt of a continuous furnace and sintered in a reducing atmosphere. Finally, the inlet feed-pipe is welded into place and flow and pressure tests conducted on the finished distributor.

Sintered metal has sufficient strength to allow the cold bending to any of the profiled shapes of current aircraft design.

Owing to the flight tests commencing late in the icing season, March 18th, only moderate success was achieved and limited conclusions were drawn by a representative test crew.

Owing to the circumstances that no definite conclusions were reached and as B. E. A. were spending large sums of money annually on the supply of de-icing fluid it became increasingly important to complete this research.

However, it was not possible to conduct further trials until the winter of 1949/50 and in the interim period a new type of distributor was developed which was tested in parallel with the standard distributor.

The "Porosint" lamina distributor

This later development in fluid de-icing equipment includes a new porous metal "Porosint" the result of years of research and experiments by Sintered Products Ltd., "Porosint", referred to in U. S. Patent Nos: 180032 and 181886 and Canadian Patent Nos: 604748 and 605055 is manufactured in open flat moulds from atomized bronze powder, spherical in particle shape and is smooth both in appearance and to the touch.

It has, however, millions of minute pores through which the de-icing fluid can exude. Thus it presents a complete homogeneous protective film on that part of the aerofoil over which it is positioned. The action of the fluid film is to destroy the bond of the ice and thus facilitate its removal.

It was established during flight trials, that with the "Porosint" panel distributors, in certain conditions (usually between 0° C. and –c° C.) the de-icing power of the fluid was sufficient to prevent entirely any ice aceration. In conditions of low temperature rime icing, it is more common for a de-icing cycle to establish itself. When this happens the first icing droplets penetrate the protective film of liquid and become partially lodged.

The subsequent layers which bond externally then act as a protection against further dilution of the fluid, and the resulting concentration at the interface rapidly destroys the adhesion of the ice which then becomes detached and is blown off by the airflow.

Although these latter flight tests proved that a major amount (over

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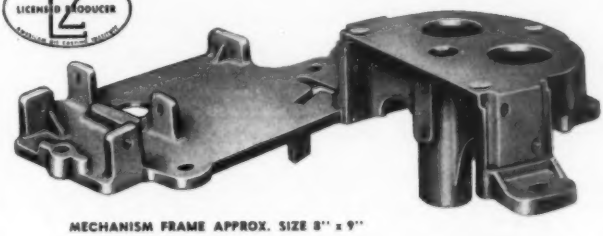

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50%) of fluid could be conserved without impairing the de-icing efficiency of the insert distributors, they also revealed that the "Porosint panels" gave 'equal if not slightly better results on half the flow rate of the standard inserts'. An examination of Figure 3 will verify this statement. This quote is from a report issued by B.E.A. who estimate that their operating costs will be decreased by £8,000 per year on the present fleet of "Viking" aircraft. The report also shows that a weight saving of 346-lbs. per aircraft can be made and a similar figure obviously will be available for revenue-producing payload. With the fitment of the new "Porosint" distributor this reduction in the consumption of fluid would be even greater.

Component parts of the "Porosint" distributor

"Porosint" offers little resistance to fluid flow, as its porosity is approximately 35%. It is therefore necessary to have some restriction interposed in

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the fluid feed system in order to obtain efficient distribution. This restriction is provided in the form of a bronze pressure mat situated between the "Porosint" and the backing sheet carrying the fluid feed channels, Figure 4. Additional control of flow rate and pressure balance between individual distributors is obtained by the introduction of small capillary tubes in the inlet of each distributor.

Each panel is fabricated by spot welding the components together. The partial solidification of the weld has practically no effect on the efficiency of the panel, for the spot areas are very small. Individual "Porosint" panels are 12" long and are made up in 7-ft. group lengths which are adequately fed by a single inlet pipe.

With a total thickness of one eighth of an inch, the addition of "Porosint" panels to the leading edge of an aerofoil involves no aerodynamic penalty and the method of fixture is simple. Alternatively, the panels can be readily embodied as an integral part of the leading edge structure during the building of the surface, to maintain fidelity of the design contour with virtually no structural complication.

"Porosint" is tough despite its extraordinary properties and its life is not materially less than that of the aerofoil surface it serves.

The new development offers complete protection from icing at such low fluid flow rates that great saving in operational cost is possible giving increased pay load. The installation involves a minimum of structural alteration to existing surfaces, or alternatively can be built in as an inherent element in any new structure.

Photographs taken during flight tests during the winter of 1950 show the type of conditions that occur in European flying. The test section, shown in Figure 3 is clear of ice, while the outboard and inboard sections not treated in any way have a dangerous ice build up. Another view is shown in Figure 5. To obtain these pictures the aircraft was flown in icing clouds and then taken above the clouds and the photographs taken.

KAISER INCREASES CAPACITY

Kaiser Aluminum & Chemical Corp. announced recently that construction is underway at its Jamaica, B.W.I., bauxite deposits to supplement present aluminum ore sources by 1,000,000 a year. Henry J. Kaiser, president of the company, also revealed the purchase or optioning of 11,000 acres of bauxite properties on the island.

Equipment has been ordered for the mining operations, a company railroad, processing buildings and a deep-water dock are being constructed.

FEDERATED ESTABLISHES MIDWESTERN DEPARTMENT

Edgar L. Newhouse, Jr., vice president of the American Smelting & Refining Co. and head of its Federated Metals Division, announced recently the establishment of a midwestern department and the appointment of Carl J. Gross as its general manager.

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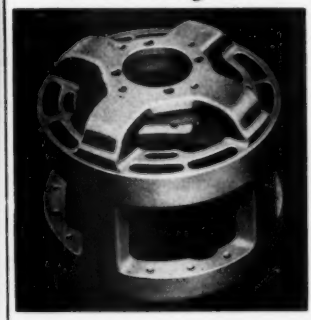

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Seein' is Believin'

FORT PRECISION IS Worth looking into

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Three types of oil pump housings made by "FORT"

FORT DIE CASTING CORP.

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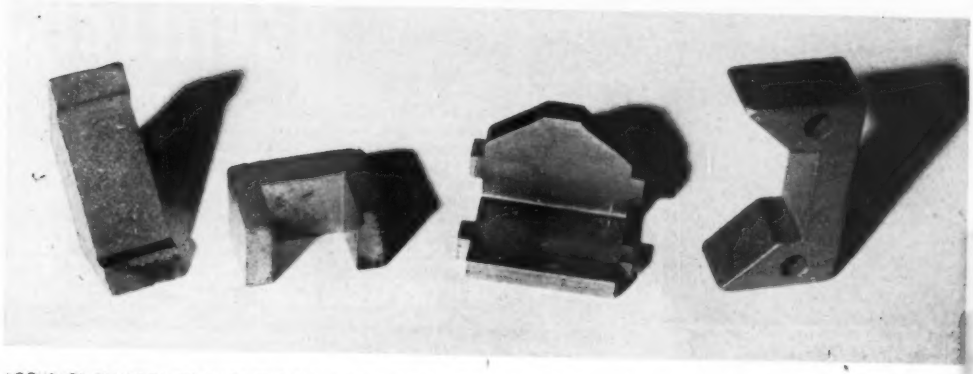
SIMPLIFIED SOLUTIONS

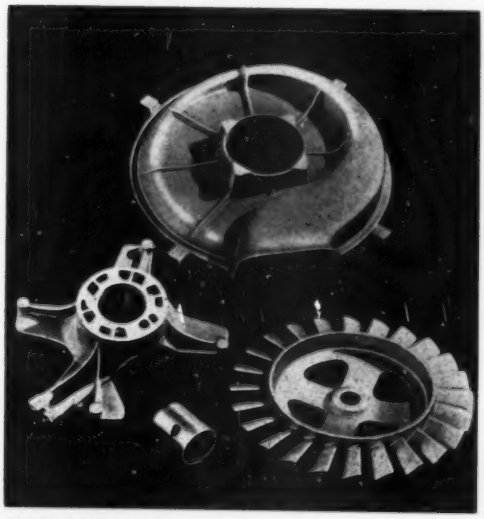
for production problems

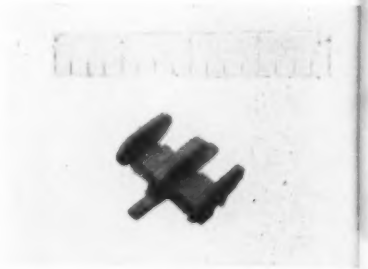


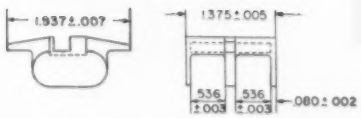
ACCURATE CONTROL OF MAGNETIC PROPERTIES as well as low cost fabrication makes powder metallurgy peculiarly adapted to the production of these magnetic contactor parts.

Made by Metal Powder Products, Inc. of Dayton, Ohio, these con actor parts are a good example of the utilization of the peculiar properties of powder metallurgy coupled with its cost reducing featu res. These parts were previously made by either cold forming or slicing a piece off a rolled shape. In either case, the magnetic properties we e poor unless the parts, after fabrication, were carefully annealed. As made from iron powder, the magnetic characteristics can be pre isely controlled by proper selection of type of powder and processing. The sintering operation automatically gives a properly anneale d piece with the desired magnetic properties. All mounting holes are cored so that the parts are delivered to the consumer ready for assem bly. Conversion to a PMM process has shown a noteworthy reduction in manufacturing cost.

CLEANER, SMOOTHER SURFACES can be obtained by producing large aluminum pieces by permanent mold casting rather than by sand casting as is evidenced by this group of parts cast by the Permold Company. Notice particularly the unusual impellor with curved vanes unsupported at outer end.







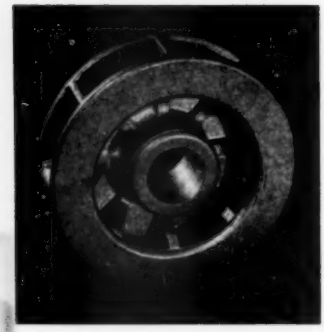
APPLYING THE PAPER BAND around a package of envelopes is a simple enough operation, but the machine that does it has to count, bundle, pick up a paper strip and paste.

In the machine the finger which picks up the paper band was formerly made up of four parts machined from bar stock.

A one piece Investment casting now does the same job. As made by Arwood Precision Casting Co., the pick-up finger need only have some mounting holes drilled and tapped to be ready for use. The surface finish achieved by the casting process is adequate for use without any work other than de-burring.

SIMPLIFIED SOLUTIONS

for production problems



THIS LIGHT-WEIGHT IMPELLER is plaster mold cast by Universal Casting Corp. out of an aluminum alloy. Extensive undercutting required in its production makes the choice of the plaster mold process the economically feasible one. The aluminum alloy used is a special high strength type developed primarily for this method of casting where the rate of chill is slow.

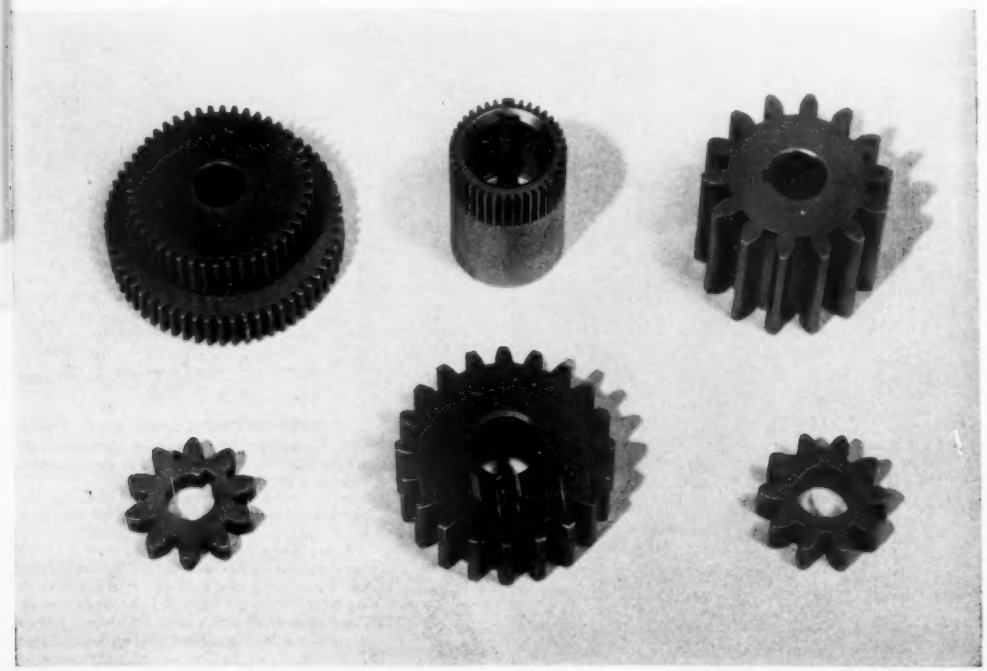
MANY PERSONS have claimed that only one basic invention has been made by mankind—the wheel. If this be true, one of the most important modifications of this basic invention is the gear.

Gears run the gamut of shape, size and form and seem to have only one characteristic in common. In one section, they are all round (or at least are supposed to be). Equally wide is the material from which gears are and have been made. Possibly the earliest were of wood, a wheel with pins driven in the edge to form rough teeth. The genesis has followed the development of materials of construction, through the metals and alloys to some of the latest of materials, plastics and metal powders.

Strangely enough, the shape of the gear teeth developed early in the use of gears and there has been little change. Tooth form for the best operation, that is transfer of maximum power with minimum wear and noise, is the involute.

Cast gears and cut gears approximate the involute, but do not achieve it. It remained for molding processes, of which powder metallurgy is one of the outstanding examples, to provide a gear with a tooth contour that is a true involute. This development of true tooth shape is one of the major contributions of powder metallurgy.

The illustration shows only a few of the many sizes, types, and styles of gears made of metal powders by the Amplex Div. of the Chrysler Corp. Almost any desired metal can be molded to form these gears and when desired other unique features such as self lubrication can be incorporated.



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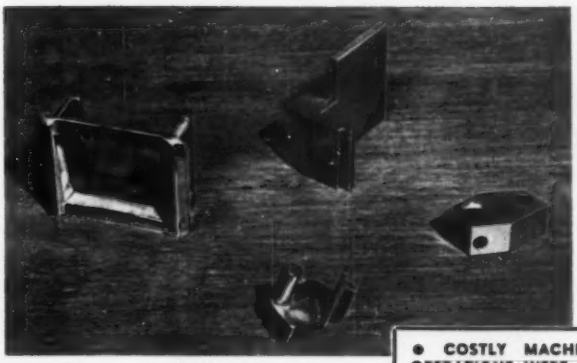

Scale: 2 to 1

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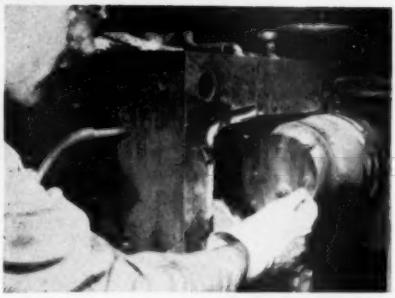

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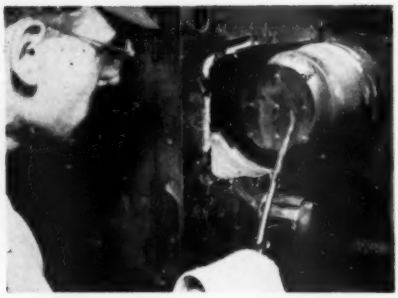
SPRAY ON TOO!



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HONOR 35 FOR SERVICE TO POWDER METALLURGY

H. E. HALL

PRESENTATION of bronze plaques to each of 35 pioneers in the powder metallurgy industry was the highlight of an anniversary dinner given by the Metals Disintegrating Company of Elizabeth, N. J. during the week of the National Metal Show in Detroit.

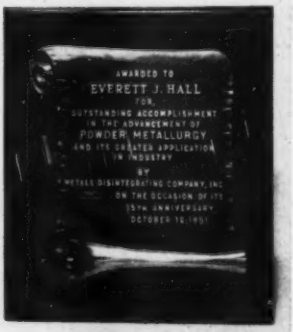
Marking its 35th anniversary, the company honored men in every phase of the industry: powder producers, parts fabricators, research and control men, technical writers and salesmen. Except for four men now deceased, nearly all of the award winners were present.

Tribute was also paid to H. E. Hall, president of Metals Disintegrating Company, by the gathering, for his part in the development of present-day powder metallurgy.

The 35 to whom bronze plaques were awarded are: Charles W. Adams, National Carbon Co.; Lawrence H. Bailey, F. J. Stokes Machine Co.; Clyde S. Batchelor, Raybestos-Manhattan, Inc.; Alfred L. Boegehold, General Motors Corp.; Elvin P. Carney, Metals Disintegrating Co.

Carl Claus (deceased), Bound Brook Oil-less Bearing Co.; James H. Davis, General Motors Corp.; Joseph E. Drapeau, Jr., The Glidden Co.; Everett J. Hall (deceased), Metal Disintegrating Co.; Charles Hardy (deceased), Charles Hardy, Inc.

continued on page 83



POWDER METALLURGY:
past, present and future

By ROBERT L. ZIEGFELD
Acting Secretary, Metal Powder Association, and
KEMPTON H. ROLL
Secretary, Standards Committee, Metal Powder Association

MORE metallic elements were first produced as powders than in any other form. As far back as historical record goes metal powders were known to be used as a base for pigments and for various decorative purposes in ceramics, paints and inks and in cosmetics.

America's greatest contribution has been the advancement of powder metallurgy from a laboratory method for making and consolidating metal powders to an industrial technique for mass producing self-lubricating bearings, electrical contacts and brushes, friction materials, magnetic cores, magnets and a host of mechanical parts.

Metal powders can be divided into two major classes which serve in effect to split them into two separate industries—flake powders and granular powders. Flake powders, on the one hand, form the basis of the metal powder pigment industry. Bronze powders, gilding powders, aluminum powders are all used in paints, printing inks and for other decorative purposes and as a group constitute the metal powder flake industry. Powders of this type will not be discussed here because they are seldom, if ever, used in the molding of parts by powder metallurgy.

Of greatest interest to the readers of this magazine, for it is that part of the metal powder industry which

TABLE I
Range of Products from Molded and Sintered Metal Powders

1. *Preparation of structures not practical by other methods:*
   - Porous bearings
   - Metallic Filters
   - Laminated structures
   - Radio and telephone cores
   - Matrix to bond babbitt to steel
2. *To provide a more economical means for fabrication of products which can be made by other methods:*
   - Parts from iron, brass and other powders
   - Alnico magnets
   - Medallions and various types of jewelry
3. *Combinations of metal and non-metallic powders:*
   - Cemented carbides
   - Cermets or ceramals
   - Current collector brushes
   - Graphite bronze bearings
   - Diamond drill core bits
   - Metallic friction articles
   - Metal powder reinforced brake bands, clutch plates and packing compositions
   - Metal powders in plastics
4. *To combine two or more metals without appreciable alloying so that individual characteristics of the metals are maintained:*
   - Electrical contacts
   - Welding electrodes
5. *Refractory metals such as tungsten, tantalum, osmium, etc.*

appears to hold the most promise for the future, is the manufacture of granular metal powders for use in powder metallurgical processes. Practically all of the commercial metals are available in granular form for use in a great variety of applications which will be described in more detail below. Granular metal powders prepared by mechanical, physical and chemical methods and differing widely from each other in particle size and shape, purity and microstructure are on the market.

The Story of Powder Metallurgy

Powder metallurgy is defined in Metal Powder Association Standard 9-50T (Definitions of Terms Used in Powder Metallurgy) as "The arts of producing metal powders and of the utilization of metal powders for the production of massive materials and shaped objects."

The coalescence of the powder particles requires the application of mechanical pressure and, in most cases, heat, but without actually melting the metal unless a liquid phase is deliberately intended, as in the cementing of carbide particles with liquid cobalt.

The powder metallurgy industry of today, one could say, began in the Western Hemisphere with the Incas in Ecuador. They were known to have worked tiny nuggets of platinum in much the same fashion as sintered hard carbides are prepared today.

But the advent of improved furnaces and the growth in importance of metals fostered the development of fusion metallurgy methods and as a result the art of powder metallurgy became practically a lost one. It was not until Wollaston in 1829 perfected a method of producing malleable platinum that powder metallurgy was resurrected as a technique for making solid metals from their powders.

The important modern use of powder metallurgy to form intricately shaped articles by pressing and sintering was suggested over a century ago but little came of it. In 1830, when determining the atomic weight of copper by the reduction of its oxides in hydrogen the chemist, G. Osann, noticed that the reduced metal sintered to a compact mass. He described in published papers methods of reproducing medallions, etc., from copper powders.

Toward the middle of the 19th Century powder metallurgy and the technique of manufacturing metal powders suffered a complete relapse. Superiority of the fusion method for producing platinum abetted by the perfection of high temperature refractories and more powerful heating equipment succeeded in eliminating the Wollaston process. Thus, an entire generation completely neglected all experiences and practices of the art except for some sporadic experimenting with the cohesion of minute metal surfaces in about 1800.

Wollaston's method was revived only toward the turn of the century when its principles were applied to the manufacture of ductile tungsten. The first metal filament for the incandescent light was made from pow-

STANDARDS FOR METAL POWDER INDUSTRY: an important function of the Metal Powder Association.

THE METAL powder industry (fabricators, powder producers, suppliers and consultants) formed an association in 1942 to represent the collective interests of the industry. The association sponsors an annual meeting and exhibit which has been rapidly increasing in scope and industry coverage since the first held in 1943.

Statistics showing monthly powder shipments compiled from data furnished by the members are supplied to members for their exclusive use.

When a new industry begins to take hold, its first attempt to stand alone is usually evidenced by its recognition of the need for standardization. Such is the case with the powder metallurgy industry. In 1945, the Metal Powder Association formed a Standards Committee comprised of representatives of member companies, whose objective was to review and study all test methods pertaining to metal powders and metal powder products and to issue as standard methods those having general application to powder metallurgy.

In the electronic core and self-lubricating oil impregnated bearing fields, the Association issued specifications covering preferred sizes and dimensional tolerances. All the Standards now in use are listed below.

MPA STANDARDS LIST

1-45 Method for Sampling Finished Lots of Metal Powders
2-48T Method for Determination of Hydrogen Loss of Metal Powders
3-45 Method for Determination of Flow Rate of Metal Powders
Supplement to 3-45—Report on Precision of Above Method
4-45 Method for Determination of Apparent Density of Metal Powders
Supplement to 4-45—Report on Precision of Above Method
5-46 Method for Sieve Analysis of Granular Metal Powders
6-48T Methods for Determination of Insoluble Matter in Iron and Copper Powders
7-49T Methods for Determination of Iron Content of Iron Powder
8-50T Method for Acceptance Tests on Structural Parts Made from Metal Powders
9-50T Definitions of Terms Used in Powder Metallurgy
10-50T Standard Tension Test Specimens for Pressed and Sintered Metal Powders
11-51T Electronic Iron Core Preferred Dimensional Specifications
12-51T Subsieve Analysis of Granular Metal Powders by Air Classification
13-51T Determination of Bending Strength, Green Density, Hardness and Shrinkage of Compacted Sintered Metal Powder Specimens
14-51T Metal Powder Sintered Bearings (Oil Impregnated) Preferred Dimensional Specifications
15-51T Determination of Green Strength of Compacted Metal Powder Specimens

dered osmium because it was impossible or impractical to draw osmium into fine wire. Modern incandescent lamp filaments and starters for fluorescent tubes are still made by using the powder metallurgy technique employing tungsten powder instead of osmium.

Development of Powder Metallurgy in the U.S.

In the second half of the 19th Century an enterprising metallurgist named Givinn obtained U. S. letters patent on bearing materials made from metal powders. His patent marked the conception of the important fundamental ideas of a self-lubricating bearing.

Toward the end of the 19th Century nickel and cobalt powders became the focus of much experimental work. Thomas Edison developed an electrolytic process for making nickel flake powders, an offshoot of his interests in the nickel-iron-alkaline storage battery.

Edison's discovery of the incandescent electric light encouraged the search for efficient materials for filaments and resulted in the successive development of osmium, tantalum and tungsten filaments from their powders. Other refractory metals of minor significance were developed by the powder metallurgy method in the early part of the 20th Century; notably, columbium, thorium and titanium.

About the time of World War I, a new application for powder metallurgy began to unfold and become one of the greatest industrial developments of the century—cemented carbides. It enabled industry to machine steels at tremendous rates—so fast that the cutting edges could become red hot without dulling.

Next came the production of composite metals for use as heavy duty contacts and other applications where it was necessary to combine the conducting characteristics of low melting metals such as silver and copper with the refractory characteristics of tungsten, platinum and others. By using these metals in powdered form and combining them by means of the powder metallurgy technique it was possible to obtain an alloy which demonstrated the advantages of both metals.

In 1921, Wilson and Loewendahl both in the employ of General Electric Company patented the modern process of making self-lubricating, oil impregnated bearings from copper, tin and graphite powders. The material was a bronze having finely divided graphite uniformly distributed throughout the mass. It was prepared by mixing the oxides of tin and copper with graphite, compressing the mass and heating. Graphite reduced the oxides leaving a porous bronze structure with excess graphite in the pores. In addition, there was sufficient porosity for the introduction of 2 to 3 percent oil.

Later developments utilized the metal powders rather than the oxides and since then self-lubricating bearings in a variety of compositions and forms have constituted

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LITEMETAL DIECAST, INC. is an organization of specialists—men thoroughly experienced in the casting and machining of magnesium and aluminum alloys. Our equipment includes big machines for big jobs—little machines for little jobs . . . the right sizes and types of the most modern die casting equipment. Our facilities are complete for producing parts from the size of a button to large cable spools.

Remember, even comparatively simple dies can be used to die cast parts at lowest cost conditions and great savings can also be made in labor formerly required for machining and finishing.

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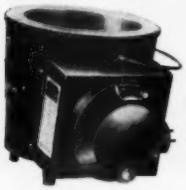
Sta-Warm electrically heated melting pots are designed to heat wax uniformly, to very exacting temperatures, holding those temperatures to narrow tolerances of 1° F. plus or minus. This assures proper fluidity of the heat to help produce perfect castings with a minimum of rejects.



Typical 4 qt wax melter with variable thermostat, model WV.

Sta-Warm melting pots are built in a wide variety of capacities to meet all your production requirements. They are built in a variety of types to fit your production line. Special features or accessories are available to tailor them to suit you.

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a large part of the total production of powder metallurgy products.

In 1923, metallic filters became the next stage in the development of porous metals. Related to the porous metal type of bearing and prepared in much the same way, filters and screens are now made from bronze, copper-nickel alloys, nickel or stainless steel powders. Porosities up to 80 percent by volume may be obtained.

Certain friction materials used in brakes and clutch devices and automatic transmissions for autos incorporate metal powders in their structure. This particular use of metal powders goes back to the year 1932.

In 1939 the industry had a total business of something less than $2,000,000 but the wartime demand for this type of material brought the annual sales figures up to more than $20,000,000 per year.

Molded iron powder cores now used in the electronic circuits of radio and television sets were first adopted in the early thirties. Today they are probably the most important application of metal powders without subsequent sintering.

Today metal powders in the form of molded and sintered products are used in a great variety of applications, as outlined in Table 1.

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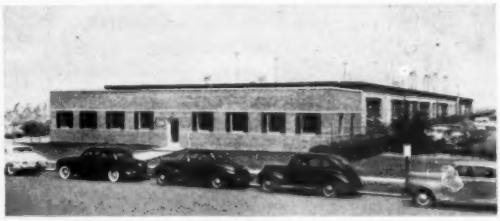
PRODUCTION CAPACITY INCREASED 400%—that's our proud announcement. As LEADERS IN PRECISION INVESTMENT METALCASTING we rapidly outgrew our old location at 6511 Cedar Ave., in Cleveland—all within 5 short years which was jam-packed with research, pre-eminent experience in successfully working with more than 125 alloys, designing and building many pieces of new and improved equipment, advancing in know-how and developing our engineering and processes of manufacturing small and intricate parts to exacting requirements. Serving over 150 national industrial concerns.



Today, PRECISION METALSMITHS, Inc., is located in our new, spacious, modern buildings, stocked with many, many pieces of new and additional equipment. We now have the facilities for serving our old customers even better, as well as having the expanded capacity to serve new customers. VISIT US — SOON!

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PRECISION METALSMITHS, Inc., 1081 E. 200th St., Cleveland 17, Ohio

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The American Metal Powder Industry Today

There is ample evidence of the rapid growth of the American metal powder industry. According to statistical data gathered by the Metal Powder Association, shipments of iron powder produced in this country had almost doubled between 1943 and 1950, going from about 2100 tons to 4100 tons. Imports of iron powder which still constitute an important source of raw material for American fabricators totaled about 6000 tons in 1950, more than doubling the 1948 imports. In 1950 the two chief iron powder consuming industries were bearings and parts and magnetic cores, each using about equal tonnage.

Copper powder shipments also doubled in the same period increasing from 6400 tons in 1943 to 13,100 tons in 1950. About 9500 tons of last year's shipment went into the manufacture of bearings and parts; about 1300 tons to friction materials and about 1000 tons to graphite metal brushes.

The Future Outlook

Numerous facts contribute to the continuance of the upward trend in popularity of powder metallurgy and its corresponding effect on the metal powder industry. Labor costs on the average probably will be

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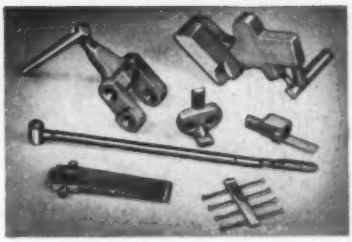
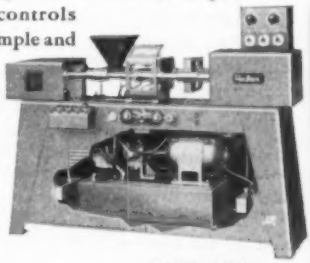


Typical precision parts produced by investment casting, using styrene patterns molded to .003" tolerances on Van Dorn Presses.

Semi-Automatic Injection Press — 2-oz. capacity. This ultra-modern press has push-button controls that are safe, simple and convenient. Accurate temperature regulation. Ruggedly built, compact and quiet.



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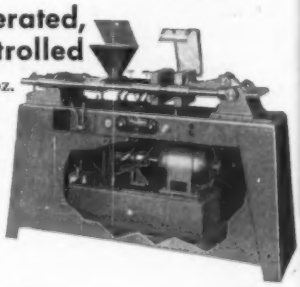

Plastic Grinder — grinds up waste, rejects, etc., for re-use.

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Write for information on this equipment.

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This is a stainless steel release cam for food machinery. Originally it was to have been machined from a 2" solid cube of steel. But made as an investment casting, all machining has been eliminated except the drilling of one small blind hole and the turning of the shank to a tolerance of ± .0005. Notice the details of the slot and cam groove which are held to tolerances of .004.

While the saving of valuable machining time is important, it is interesting, too, that an actual saving of 58% was made over the cost of making the cam by other methods.

Perhaps you have a production problem that Arwood can help you solve. Our engineers, with years of experience in many industries, often are able to make valuable suggestions that result in important savings in manufacturing.

For more complete information about the accuracy, the lower costs and the versatility of precision casting, write for our booklet, "A Critical Survey of Investment Castings."

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not far below the present value under any forseeable conditions.

As the world's need for goods increases and labor costs stay high, there will undoubtedly be an increasing demand to make things by machines and here the powder metallurgy process offers a real advantage. In three operations machining and special treatment requiring skilled labor are virtually eliminated, hence large pools of skilled labor are not a requisite of the powder metallurgy process.

Economy of results will also dictate more production by powder metallurgy for the material economies are often great. Scrap metal in machining from bar stock or castings often runs as high as 50 percent especially if parts are small or have holes in them. On the other hand, there is no metal waste in metal powder processing. The powder that is not used in the die the first time is simply collected and used in a subsequent pressing.

Furthermore, metal powder processing sometimes saves an additional 25 percent of metal by reducing density in areas where the part requires the least strength.

Of course, powder supply will affect metal powder production costs. If the present trend magnified by the

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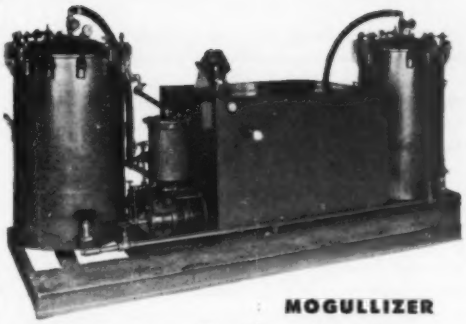
current interest in ordnance materials for the defense program continues, it is likely that powder production will have to be very much greater than it is at present. For example, our pre-Korean industry consumed more than 10,000 tons of iron powder alone each year. Now defense officials indicate that domestic consumption may expand anywhere from 10 to 100 times this figure. At the present time new facilities to meet the expected need are being constructed.

Developments such as these will automatically widen the market for metal powder products. New techniques in powder metallurgy will also widen the areas in which metal powders can profitably be utilized and new products, as a result of these techniques, will in turn create more new industries and new markets.

High speed cutting tools, powerful permanent magnets, electronic cores from iron powder, are all examples of new markets developed by powder metallurgy.

Much has been printed in recent years about the application of powder metallurgy to the manufacture of mechanical parts picturing it as a panacea.

While it is true that sometimes spectacular cost savings have been gained through the application of powder metallurgy to parts which were formerly produced by other means, it must be remembered that for as many successful applications, there are probably as many marginal cases for which its use may be a "toss



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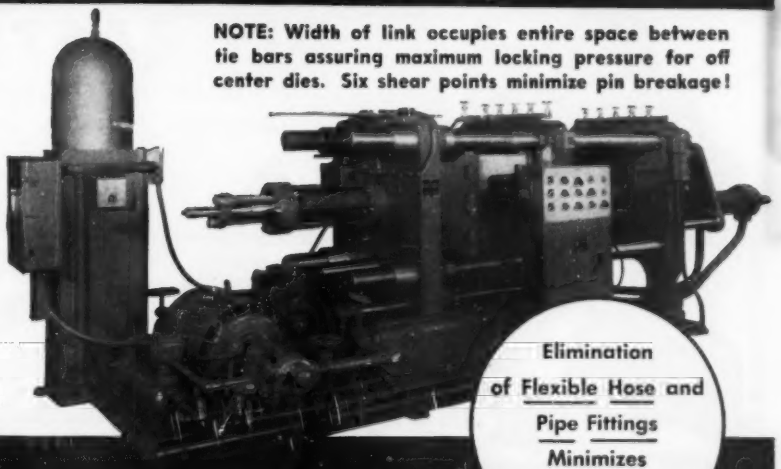

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up," or for which the powder metallurgy method actually has nothing to offer. For example, the part must be suitable in size and shape for this method of fabrication, it must be required in sufficient quantity to justify the costs of the dies and special tools, it must have physical properties within the limits of economic production in competition with other methods of fabrication. It should be understood that the physical characteristics of the part made from metal powder may not necessarily correspond to those of the part produced by other methods, though changes in design may oftentimes circumscribe this limitation and enable powder metallurgy to be used profitably.

If the above limitations are recognized, a combination of enough of the following advantages of powder metallurgy can usually make the operation economically attractive:

1. high production rate,
2. fewer operations,
3. close tolerances,
4. little or no machining,
5. no finishing,
6. no scrap loss,
7. controlled density variations,
8. wear resistance,
9. self-lubrication,
10. alloys or combinations not possible by other methods.

The value of the products of the entire metal powder industry, that is, metal powders, metal powder parts and other fabricated items was placed at approximately $125,000,000 in 1949. It also has been estimated that the number of bearings and parts produced in 1949 was well over a billion and that these items alone consumed about 15,000 tons of powder.

This year the estimated value of the industry is placed at about $200,000,000.

The rise of powder metallurgy from a little known art to a recognized industrial technique has literally mushroomed since its beginning after the first World War. The American appreciation for mass production and our skill for translating theoretical knowledge into practical "know-how" has fostered this new industrial technique to the point where it has become a permanent part of our production scheme.

Even without the help of the defense program and its resultant increased demand for parts made by the powder metallurgy technique, the future for powder metallurgy in a normal economy looks bright—providing it is realized that, like die casting and investment casting, powder metallurgy is just another precision metal molding method with limitations that must be recognized and shortcomings yet to be overcome.

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ASTE COMMITTEE NAMED

A General Committee on Arrangements has been appointed to arrange and carry out a number of special events for the 50th anniversary meeting of the American Society for Testing Materials to be held in New York the week of June 23, 1952. Heading the committee of 75 will be ASTM past president J. R. Townsend, materials engineer for the Bell Telephone Laboratories.

At the organization meeting in September it was announced that numerous special symposiums are being developed as part of the technical program. In all, some 35 sessions will be necessary to take care of the large number of papers and reports.

35 HONORED
continued from page 74

John M. Hildaboldt, Metal Powder Products, Inc.; William F. Jennings, Bound Brook Oil-less Bearing Co.; Clarence A. Kerner, National Molded Products, Inc.; Richard H. Khuen, Becker Bros. Carbon Co.; Roland P. Koehring, General Motors Corp.

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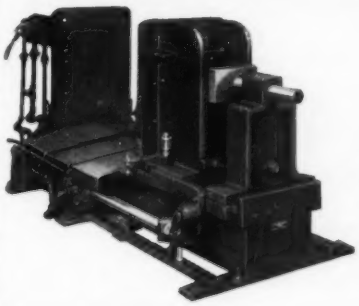

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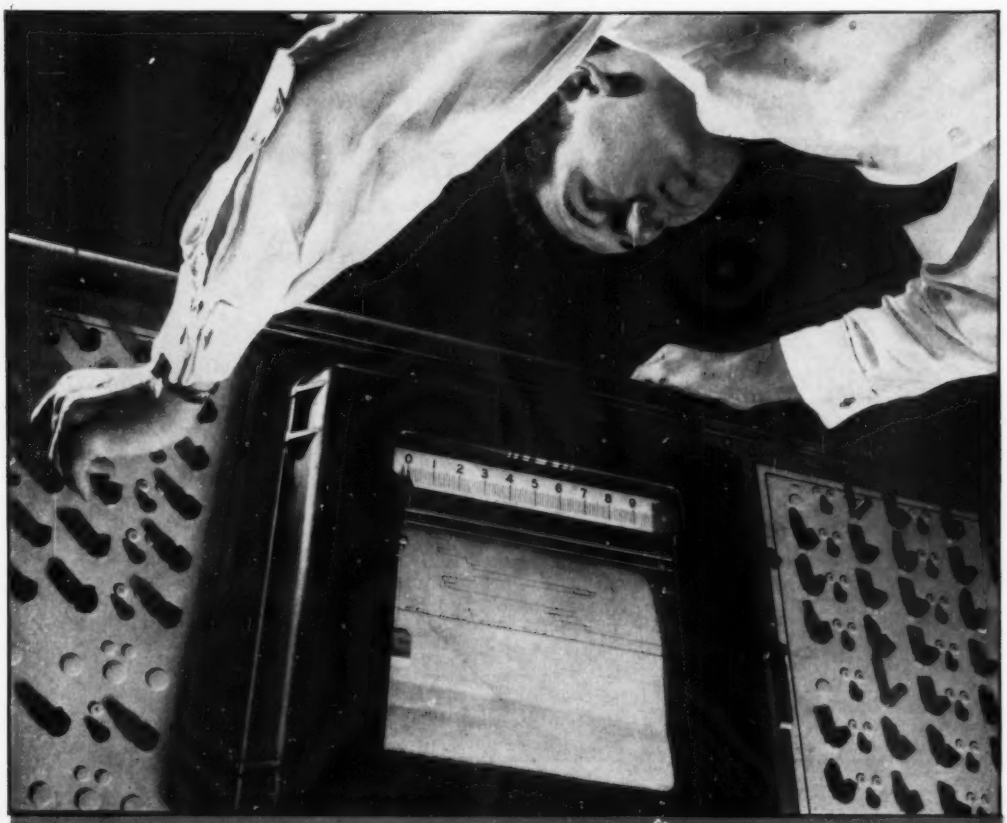

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